PB81-179806

The Use of Existing and Modified Land Use Instruments to Achieve Environmental Quality

Urban Systems Research and Engineering, Inc.
Cambridge, MA

Prepared for

Environmental Protection Agency
Washington, DC

Mar 79

U.S. Department of Commerce
National Technical Information Service
NTIS

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1. REPORT NO.
EPA 600/5-79-006

2.

3. RECIPIENT'S ACCESSION NO.
PB81 17980 6

4. TITLE AND SUBTITLE
The Use of Existing and Modified Land Use Instruments to Achieve Environmental Quality

5. REPORT DATE
March 1979

6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)
Michael R. Alford
James F. Hudson

8. PERFORMING ORGANIZATION REPORT NO.

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Urban Systems Research and Engineering
1218 Massachusetts Avenue
Cambridge, MA 02138

10. PROGRAM ELEMENT NO.
1HC619

11. CONTRACT/GRANT NO.
68-01-3231

12. SPONSORING AGENCY NAME AND ADDRESS
U.S. Environmental Protection Agency
Office of Research and Development (RD-682)
Washington, D.C. 20460

13. TYPE OF REPORT AND PERIOD COVERED
Final

14. SPONSORING AGENCY CODE
EPA/600 (ORD)

15. SUPPLEMENTARY NOTES

16. ABSTRACT

This report reviews the application and potential of the police power at the local level of government as it is used to achieve environmental planning objectives. The first section presents an overview of the interactions of various municipal regulations and ordinances as they affect the environment. Subsequent sections examine the potential of conventional, locally available, legal tools to affect residuals production--these include transportation and parking ordinances, building codes, on-site wastewater management and maintenance permits, stormwater management ordinances, noise control ordinances, solid waste ordinances, and subdivision permit procedures. In each section, examples of successful or model ordinances are supplied, preceded by a discussion of the technical issues involved in associated environmental programs. The last section of the report is a two-part appendix that elaborates on the impacts of various commonly used ordinances on individual factors of environmental quality; it serves as an extension of the overview presented in the first section.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
*Management, *Planning, *Regulations, Urbanization, Local Government, Land Use, Environments	*Institutions, *Environmental Control, Institutional Constraints, Legal Aspects	6E

18. DISTRIBUTION STATEMENT
Release to Public

19. SECURITY CLASS *(This Report)*
Unclassified

20. SECURITY CLASS *(This page)*
Unclassified

21. NO. OF PAGES
370

22. PRICE

EPA Form 2220-1 (9-73)

[illegible] -281-147/27

ATTENTION

AS NOTED IN THE NTIS ANNOUNCEMENT, PORTIONS OF THIS REPORT ARE NOT LEGIBLE. HOWEVER, IT IS THE BEST REPRODUCTION AVAILABLE FROM THE COPY SENT TO NTIS.

United States
Environmental Protection
Agency

Office of Air
Land and Water Use
Washington DC 20460

EPA 600/5-79-006
March 1979

PB81-179806

Research and Development

EPA

The Use of Existing and Modified Land Use Instruments to Achieve Environmental Quality

PRODUCT OF:
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

EPA 600/5-79-006
March 1979

IMPROVING ENVIRONMENTAL QUALITY THROUGH THE USE OF LOCAL ORDINANCES AND REGULATIONS

by

Michael R. Alford
James F. Hudson
Urban Systems Research & Engineering, Inc.
1218 Massachusetts Avenue
Cambridge, Massachusetts 02138

Contract No. 68-01-3231

Project Officer

Charles Ehler
Office of Research & Development (RD-682)
U.S. Environmental Protection Agency
Washington, D.C. 20460

OFFICE OF AIR, LAND, AND WATER USE
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

DISCLAIMER

This report has been reviewed by the Office of Research and Development, U.S. Environmental Protection Agency, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the U.S. Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

FOREWORD

The Environmental Management Research program in the Office of Air, Land and Water Use, Office of Research and Development, U.S. Environmental Protection Agency, is unique in its emphasis on intermedia effects, on the integration of institutional and technological environmental management strategies, and on a complete range of implementation measures, including economic incentives, land use management, public education and traditional regulatory mechanisms.

This report reviews the interactions of various municipal regulations and ordinances affecting the environment, and examines the potential of conventional and locally available legal tools to improve the effectiveness of their environmental programs. The local approaches to residuals management presented here are designed to complement broader comprehensive regional programs for the achievement of ambient environmental quality standards.

Courtney Riordan
Acting Deputy Assistant Administrator
Office of Air, Land, and Water Use

ABSTRACT

This report reviews the application and potential of the police power at the local level of government as it is used to achieve environmental planning objectives. The first section presents an overview of the interactions of various municipal reulations and ordinances as they affect the environment. Subsequent sections examine the potential of conventional, locally available, legal tools to affect residuals production--these include transportation and parking ordinances, building codes, on-site wastewater management and maintenance permits, stormwater management ordinances, noise control ordinances, solid waste ordinances, and subdivision permit procedures. In each sections, examples of successful or model ordinances are supplied, preceeded by a discussion of the technical issues involved in associated environmental programs. The last section of the report is a two-part appendix that elaborates on the impacts of various commonly used ordinances on individual factors of environmental quality; it serves as an extension of the overview presented in the first section.

CONTENTS

Disclaimer Notice i
Foreword ii
Abstract iii
List of Figures vi
List of Tables vii

0. Introduction 1

I. An Overview of Local Use of the Police Power to Improve Environmental Quality 4
    The Role of the Police Power 4
    The Matrix of Interactions Between Environmental Quality Factors and Local Regulations and Ordinances 7

II. Transportation and Parking Management 18
    Environmental Impacts 18
    Types of Parking Controls 20
    Impacts and Costs of Controls 23
    Ordinances and Technical Data 26

    Appendix II-1: An Ordinance for Parking Facility Review by Local Governmental Entities 28
    Appendix II-2: Rules and Regulations - Residential Permit Parking Program 33
    Appendix II-3: A Resolution Adopting an Interim Parking Policy for the Central Business District 35

III. Space Heating and Home Energy Consumption 42
    Environmental Impacts of Space Heating 42
    Standards and Incentives for Improved Insulation 53
    Air Pollution Effects of Zoning and Land Use Changes 64

    Appendix III-1: Building Standards and Technical Data 66

IV. On-Site Wastewater Disposal 86
    Environmental Impacts of On-Site Disposal 86
    Improvements in On-Site Waste Management Systems 95
    Costs of On-Site Disposal 113
    Technical Data 116

CONTENTS (continued)

V. Stormwater Management 127
Stormwater Management and Environmental Quality 127
Stormwater Management Controls 135
Implementation and Costs 149
Ordinances 151

VI. Noise Control Ordinances 166
Environmental Impacts of Noise 166
Types of Noise Control 169
Effectiveness and Cost of Noise Controls 175
Ordinances 178

Appendix VI-1: Model Community Noise Control Ordinance 180

VII. Solid Waste Control 216
The Solid Waste Problem 218
Options for Improvement 223
Rating the Options 231
Ordinances and Equipment 236

Appendix VII-1: An Ordinance 239
Appendix VII-2: Suggested Solid Waste Management
Ordinance for Local Government 247

VIII. Subdivision Ordinances for Local Environmental Review 267
Environmental Impact Reviews on the Local Level 267
Natural Resource Inventories and Performance Standards 272
Costs of Implementation 297
Sample Ordinances 299

APPENDIX I-1 316

Appendix I-2 339

FIGURES

NUMBER PAGE

1 Effect of Parking on Curb Sweeping 26

2 Normal Number of Degree Days Per Year 45

3 Septic Tank Schematic 90

4 Typical On-Site System 91

5 Layout and Specifications of Typical Trench System.......... 92

6 Daily Household Water Use 100

7 COD Profile 101

8a Layout of a Field with an Even Number of Trenches 106

8b A Flow Diversion Valve with an External Regulatory Key...... 106

9 Mound Over Creviced Bedrock 111

10 Typical Pressure Sewer Installation 112

11 Percent Increase in Number of Floods at Various Levels of Urbanization 129

12 Graphic Representation of Stormwater Runoff Pollution 131

13 Annoyance From Noise 169

14 Fixed Source Noise Levels Allowable at Residential District Boundaries 171

15 Increases in Citizen Participation in Recycling Over Time 227

16 Computer Map of Bucks County, Pennsylvania 274

17 Composite Computer Map of Bucks County, Pennsylvania 275

18 Enlarged Computer Map, Showing Loss of Usefulness on Local Level Site Reviews 276

19 Matrix I 286

20 Matrix II 287

21 Matrix III 288-289

22 Matrix IV 290-291

23 Matrix V 292

TABLES

NUMBER PAGE

1 Applications of the Police Power to Improve Environmental Quality 8-9

2 Air Pollution Vehicle Controls and Air Quality............ 18

3 Street Runoff Compared to Treatment Plant Effluent 19

4 Typical Parking Requirements 20

5 Resident Permit Parking Program--Washington, D.C. 22

6 Effectiveness of Parking Controls 24

7 Feasibility of Parking Controls 25

8 Percentage Heating and Cooling Energy Consumption Savings for New Construction Measures in Residential and Commercial Buildings 43

9 Approximate Heating Requirements for the Characteristic Single Family House Under Different Climatic Conditions.... 46

10 Approximate Air Pollution Emission Reductions Due to Improved Insulation of Single Family Houses................ 48

11 Net Air Pollution Emission Reductions for a Block of Characteristic Townhouses (6 dwelling units) With Improved Insulation 49

12 Net Air Pollution Emission Reductions for a Characteristic Low-Rise Apartment Building (24 dwelling units) With Improved Insulation 50

13 Approximate Water Pollution Emission and Solid Waste Reduction Due to Improved Insulation of Electrically Heated Single Family Houses 52

14 Approximate Fuel Savings Accruing to Improved Insulation of a Characteristic Single-Family House 56

15 The Net Value of Insulation Improvements in Various Climates 58

16 Present Value of Improved Insulation to a Homeowner Who Plans to Sell in Four Years 60

17 Savings 62

18 Housing Units and Population Served by Sewers and On-lot Sewage Disposal Systems in the United States 87

19 Housing Units and Population Served by Sewers and On-lot Sewage Disposal Systems in Rural and Urban Areas 87

TABLES (continued)

NUMBER PAGE

20 Housing Units and Population Served by Sewers and On-lot Sewage Disposal Systems Inside and Outside SMSAs* 87

21 Septic Tank Design and Water Depth Requirements in Various States 96

22 Absorption Field Design Requirements in Various States..... 97

23 Replicate Percolation Tests Performed for Three Soil Firms 99

24 Conventional Septic Tank System 114

25 Aerobic System Costs 115

26 Calculated Quantities of Pollutants Which Would Enter Receiving Waters in a Hypothetical City 133

27 1973 Costs of Deicing 141

28 Comparison of Quality Characteristics from First Flushes and Extended Overflows of a Combined Sewer (7) Hawley Road Sewer, Milwaukee, Wisconsin 144

29 Estimated Costs of Sewer Separation in Various Cities...... 146

30 Estimated Flushing Costs for Demonstration Project Detroit, Michigan.......... 148

31 Costs of Erosion and Sedimentation Control Measures 152

32 Yearly Average Equivalent Sound Levels Identified As Requisite to Protect the Public Health and Welfare With an Adequate Margin of Safety 167

33 Continuous Sound Levels Which Pose an Immediate Threat to Health and Welfare 168

34 1975 Review of Community Noise Control Ordinances 170

35 Caltrans Measurements of Automobile Noise 173

36 Problem Noise Sources 176

37 Responsibility for Noise Control 177

38 The Wide Range of Pollutant Levels in Leachate Composition 220

39 The Impact of Visual Environmental Quality on Littering.... 228

40 Common Litter Norms 229

41 Measurements of Litter Accumulation in Clean Community System Communities 230

42 Evaluation of Management Improvements.......... 232

TABLES (continued)

NUMBER PAGE

43 Runoff Management Chart 279

44 Guidelines for Municipal Resource Inventory 281-282

45 Natural Factors 283-284

46 Selected Performance Standards 295-296

A-1 Applications of the Police Power to Improve Environmental Quality 340-341

SECTION 0

INTRODUCTION

Environmental management has always been one of the prime concerns of local government, though the term itself is relatively new. Since the publication of Rachel Carson's Silent Spring in 1962, awareness of the environment as a target for government action at all levels has grown by leaps and bounds. At the same time, the definition of environment has expanded until now it can be read to include education, economic development, employment, and other "quality of life" criteria. Local governments have responded in many positive ways to this new perception of their responsibilities, but there is no concensus about what their role should be, either in relation to their citizens and their physical surroundings, or in relation to higher levels of government and national land use and natural resource priorities.

A survey for the Environmental Protection Agency conducted in 1974* asked local governments to define the word "environment." The first definition suggested restricted the meaning to the natural environment, and included categories of pollution such as air, noise, sewage, solid waste, and toxic substances--in short, most of the traditional environmental concerns of local sanitation departments, planning boards, and police forces. The second definition widened the interpretation somewhat to include energy, historical preservation, land use, open space, radiation, population, and wildlife preservation. The third added aesthetics, health, housing, mass transportation, recreation, streets, and highways; the fourth included the "quality of life" categories alluded to above (education, economic development, employment, public safety and welfare). Interestingly, more than half the respondents picked one of the two broader interpretations of environment, even though it also became clear that environmental problems rank below other local government concerns in priority, and that local resources for effective environmental management are perceived to be inadequate.

This report uses the more restrictive definition of environmental management. It surveys what local governments can do to improve the effectiveness of their more conventional and traditional environmental programs, especially through the adoption of improved ordinances in such basic areas as stormwater management, wastewater control, and solid waste collection. If there is one over-riding problem in this area, it is a shortage of resources with which to find new approaches to old problems, shape them to local needs, and use them effectively. The objective here is to acquaint local officials with some of the more effective approaches developed in various communities--approaches that can be implemented with a minimum of resources and degree of difficulty through municipal ordinances or established municipal programs.

---

*S. Carter; M. Frost; C. Rubin; L. Sumek, Environmental Management and Local Government, Office of Research & Development, U.S. Environmental Protection Agency, Washington, D.C., February 1974.

There were two steps involved in identifying these approaches to improving environmental quality on the local level. First, a survey of municipal uses of the police power was conducted. This identified the range of ordinances used on the local level for control of land use and maintenance of environmental quality. These ordinances were then compared to areas of concern in the natural environment, with attention paid to where ordinances could be used for more than one purpose. Next, a few topics were selected for further development: these correspond to EPA's general areas of concern nationwide, and include air pollution (both from mobile and stationary sources), water pollution (from point and non-point sources), solid waste management, noise, and environmental impact review.

Section I presents the results of the survey of municipal uses of the police power. The links between individual ordinances and the environmental factors they affect are shown on a matrix, individual cells represent interactions described in the text.

Sections II through VIII cover the selected topics. They are:

II Parking and Automobile Use Restraints: Reduction in auto use is often called for as a way to reduce air pollution. This chapter discusses parking controls in pursuit of this objective, and notes their important role in relation to water pollution control.

III Space Heating and Home Energy Consumption: Insulation improvements can cut down on the burning of heating fuels, with consequent reductions in air pollution emissions and local energy use. This chapter stresses programs for implementation of insulation improvements.

IV On-Site Wastewater Disposal: There is a revival of interest in on-site disposal as an alternative to municipal sewer sites. This chapter discusses ways to improve the performance of on-site systems and prolong their useful lives.

V Stormwater Management: Localities are not often aware enough of the pollutant content of stormwater. This chapter discusses this problem and outlines a number of avenues of improvement.

VI Noise Control: Many municipalities have initiated noise control programs; the issues are discussed in relation to EPA's development of a model noise ordinance.

VII Solid Waste Storage and Collection: Solid waste management is one of the most important concerns of local government; the problems of improving performance are discussed, and EPA's model ordinance is presented.

VIII Subdivision Ordinances for Local Environmental Reviews: Environmental impact review at the local level is an underutilized process of great potential; this chapter presents methods by which an effective review process can be set up relatively cheaply, and gain public acceptance.

The topics selected in the later chapters are basically concerned with the management of residuals discharge and maintenance of the integrity of natural systems. The broader issues of land use controls are avoided quite deliberately, as are comprehensive programs for the analysis and management of ambient environmental quality in the areas of air and water pollution. Local land use controls, especially zoning, have been studied extensively elsewhere; innovative approaches in this area, especially such concepts as emission density zoning and transferable development rights, were considered beyond the resources of this project to treat in sufficient depth. Comprehensive programs for the achievement of ambient environmental quality standards are more appropriately the concern of regional planning agencies; Air Quality Control Regions, Air Quality Maintenance Areas, and 208 Areawide Planning Regions have been set up under the Clean Air Act and the Water Pollution Control Act to deal with ambient quality problems on the appropriate regional level. The local approaches to residuals management presented here are designed to complement such regional approaches.

SECTION I

AN OVERVIEW OF LOCAL USE OF THE POLICE POWER TO IMPROVE ENVIRONMENTAL QUALITY

THE ROLE OF THE POLICE POWER

Under the Tenth Amendment to the Constitution, various sovereign powers, collectively referred to as the police power, are reserved for the states. These include the power to regulate private activities in the interest of public health, safety and general welfare; the power to tax and spend both for public welfare and for the maintenance of government; and the power to acquire, manage, and dispose of property for public purposes. All of the approaches to the improvement of environmental quality brought forth in this report use the police power as their ultimate source of authority.

The use of the police power is limited at all levels by a number of constitutional constraints. First and foremost, this power must be applied in the public interest, and any governmental intervention in private affairs must be necessary to accomplish a public purpose. Due process must also be observed, and no class of persons may be unreasonably discriminated against in the pursuit of public objectives. Most important for many of the land use controls commonly used by local governments, no property may be taken for public use without just compensation.

Many of the states' constitutional police powers are delegated to local governments (counties or municipalities) under the "home rule" provisions of state consistutions by enabling statutes. Local governments have no inherent authority of their own under the federal constitution; in all their powers they are creatures of the states. In practice, however, their powers are fairly broad. "Home rule" attempts to define a separate sphere of legislative jurisdiction within which local governments may operate independently of the state; other state enactments delegating the police power may be almost as wide in effect. In general, localities may enact restrictions on private activities that are more stringent that state restrictions except where there is a direct conflict of objectives, in which case state enactments automatically prevail. States may also preempt certain fields of regulation where they deem that state needs transcend local concerns; in such cases, localities have no room at all to enact their own regulations. In the field of environmental law, however, the powers of local governments are largely unimpeded by state priorities--local governments generally have more power than they are willing to assume.

Whenever local governments enact restrictions that may diminish the value of land for private development, the issue of "taking" is raised.[1] There has always been a fine line between what constitutes valid regulation of private activity in the interest of the public health, safety, and general welfare, and what can be interpreted as an "unreasonable" restriction of property for public purposes. Under numerous court decisions, property does not need actually to be acquired by government for a taking to exist. A "virtual taking" (or "inverse condemnation") may be declared where the value of property is diminished by public actions for insufficient cause; the community must then compensate the owner. Just what constitutes "sufficient cause" is the crux of the issue.

While there is no simple answer to this, a general rule of thumb is emerging as courts find themselves in the midst of numerous debates over the proper use of land for maintaining environmental quality. Where restrictions on the use of land are enacted in order to avoid a public harm, broadly defined, these restrictions are increasingly being upheld. Where they are enacted to further a public good, compensation of owners is almost always required. Thus, restrictions on development in aquifer recharge areas may be upheld without compensation to owners if they are enacted to protect a safe and adequate water supply for the town, but not if they are justified in the name of preserving open space and scenic values.

Many local governments still are timid in their enactment of environmental statutes and land use controls, fearing to intrude in any way on the traditional ethic that what an owner does with his own land is his own concern, especially where he wishes to profit from it financially. This ethic is not confirmed by constitutional law, but it dies hard. Over the past few years, many communities have broken new ground in regulating private activity for environmental ends: a program restricting the number of building permits a town may issue in a given year has been upheld in Petaluma, California; the regulation of growth by capital facilities planning has been used successfully in Ramapo, New York; and the restriction of development on wetlands and other sensitive lands has been successful in many localities. Even so, controversy in this area of the law has reduced the initiative many communities might otherwise have shown.

Regulation of Residuals Generation and Discharge

Environmental quality problems begin with residuals generation and discharge--the introduction of substances into the natural environment: air, land, or water. Tracing the origins of general environmental modification back to remote individual sources of pollution is an extremely difficult task. For instance, recently it has been shown that flurocarbon propellants from aerosol spray cans are reducing the planet's ozone layer, a remarkable example of the distance between cause and effect in environmental management. Many legislative programs, the most notable being the 1972 Water Pollution Control Act Amendments (P.L. 92-500), no longer base their entire approach on such analysis, but instead concentrate in principle on the control of pollution sources.

The term "residual" is often used interchangeably with "pollutant," but it carries a slightly different meaning in an environmental context. A pollutant is a substance or energy form that tends to interfere with natural environmental processes; a residual is taken to be a pollutant, discharged in connection with human activities, that has a cost of recovery exceeding its market value. A hierarchy of tools exist to manage the production of residuals: on the lowest level are those physical or technological methods that change the quantity, type, timing, or spatial location of residuals that are discharged, or that improve the assimilative capacity of the environment; on the next level are the regulatory, economic, administrative, and educational tools that induce the implementation of desirable physical methods or residuals abatement; on the third level are the institutional arrangements whereby environmental goals are established and implemented measures selected and enforced. It is on the institutional level that governmental actions come into play.

Various levels of government have different potentials and opportunities for residuals management, and encounter different problems. One of the difficulties in managing residuals on the local level is that some of the most powerful tools available to control pollution are also the broadest in scope. The obvious example is zoning. The use of zoning can do much to control where residuals are generated (by controlling the intensity of land use), and what types of residuals are generated (by controlling permissible activities on the land). But zoning has so many other economic, social, and political effects that it cannot be wielded with only environmental purposes in mind. As a consequence, it has proven ineffective in managing environmental quality. While any number of variations on zoning have been developed, many of them potentially effective in managing residuals productions and improving many other aspects of environmental quality, few have been implemented.

The focus of this report is, therefore, on the more narrow instruments of residuals management available to local governments. Until the comprehensive instruments are more fully developed and more widely adopted, a great deal can be accomplished by improving local sanitation ordinances, parking ordinances, and the like. These tools are for the most part familiar instruments whose application is not controversial, and they often have impacts beyond their immediate targets of concern that can be exploited for extra environmental benefits. Implementing some of the improvements as suggested in the later chapters of this report will, inevitably, impose costs on the private and public sector; however, the environmental benefits conferred by these controls are so clearly linked to the protection of the public health, safety, and welfare, and the restraints they impose on local prerogatives for land use controls are so limited, that they can be widely adopted.

MATRIX OF INTERACTIONS BETWEEN ENVIRONMENTAL QUALITY FACTORS AND LOCAL REGULATIONS AND ORDINANCES

Any comprehensive environmental policy implemented on the local level of government should be based on an understanding of the interactions between environmental quality factors and commonly enacted ordinances and regulations. Since ordinances are likely to have an effect on more than one aspect of environmental quality, it is useful to trace out the major interactions on a matrix such as Table 1. Along one axis are listed various local ordinances, regulations, and other uses of the police power; along the other are the environmental parameters which they affect.

This matrix is not exhaustive on either side. It emphasizes areas of concern to local governments, and is biased toward the programmatic interests of the U.S. Environmental Protection Agency. The basic uses of the police power are selected with a view toward their impacts on areas where the EPA has an explicit legislative mandate; aesthetic and similar environmental subjects are included only insofar as they interact with other areas. Also de-emphasized are areas such as toxic substances control, where EPA has a major interest but where the actions of local governments play only a marginal role. Certain innovative ordinances, such as growth controls and transferable development rights, are not presented at all: these tools have been the subject of other in-depth studies, and are also only now being tested; there is a large body of analysis and little practical experience.

The major problem in any review of local government actions is providing a single framework on which to hang the almost endless variations of practice that are found. One method of land use control may occur in a number of guises--as a zoning ordinance, a subdivision regulation, or even a construction code specification. To avoid redundancies in the presentation, a breakdown has been adopted that seeks to unify and simplify this variety without losing its content. Twenty-one generic instruments have been defined.

In some instances, inconsistencies are inevitable. For example, cluster subdivisions and planned unit development form a logical pair--both seek to increase a developer's siting flexibility under otherwise rigidly prescriptive siting regulations, and both achieve basically the same environmental benefits. Yet the first is implemented by subdivision regulations (and does not even require a valid zoning ordinance), and the second is an explicit exception to an existing zoning ordinance. Groupings were made on the basis of similar environmental impacts, preferred mode of implementation, or simply by arbitrary assignment.

The first section below defines, very briefly, the environmental factors presented in the matrix. Each entry is described in a paragraph or two, and its local government context is reviewed. The reader's familiarity with basic environmental issues is assumed.

The second section below briefly defines the ordinances and regulations on the matrix axes, and appraises their potential for improving local environmental quality. References are made to discussions in Sections II-VIII as appropriate. A more detailed exposition of these categories of ordinances is provided in Appendix I-1.

TABLE 1

APPLICATIONS OF THE POLICE POWER TO IMPROVE ENVIRONMENTAL QUALITY

		ZONING				SUBDIVISION REGULATIONS				LAND ACQUISI-TION
		General Districts Lot Specs	Sensitive Areas	Perfor-mance Zones	Flexible Zoning	Water & Sewer	Stormwater Management	Streets	EIS	Less-than Fee
AIR POLLUTION	Non-Point	▨	▨		▨	▨			◤	◤
	Mobile	▨	▨		▨			▨	◤	
	Point								◤	
WATER QUALITY	Non-Point	▨	▨		◤	▨	▨		◤	◤
	Point	◤		▨		▨	▨		◤	
	Groundwater	◤	◤			▨			◤	◤
WATER QUANTITY	Flooding	◤	▨	▨		▨	▨		◤	◤
	Supply	◤	▨			▨	▨		◤	◤
SOLID WASTE		◤			▨	▨			◤	
NOISE		◤	◤		◤				◤	◤
OTHER	Aesthetic Wildlife	▨	▨		▨	▨	▨	▨	▨	◤
	Toxic Substances					▨			◤	
	Energy: Transportation	▨			▨				◤	
	Energy: Buildings				▨				◤	
	Soils								◤	

Table I continued

LAND ACQUISITION	CODES			REGULATIONS/ORDINANCES							
Land-Banking	Construction	Building	Health	Flood	Sanitation	Tree	Burning	Parking	Noise	Erosion/ Sedimentation	Runoff
◩		▨					▨			▨	
						▨		◩			
◩		◩		◩	◩			▨		▨	▨
◩		◩		◩				◩			◩
◩		▨		▨		▨				▨	▨
▨			◩	◩						▨	▨
▨	▨	▨	◩		◩		◩				
	◩	◩	◩		▨	▨		◩	▨		
◩		▨	▨	◩	▨	▨		◩			▨
		▨	◩	▨	▨						
								◩			
		◩	▨								
	▨									▨	

▨ Direct and explicit relationship exists between the Environmental Quality Factor & Ordinance or Regulation

◩ Indirect or conditional relationship exists between the Environmental Quality Factor & the Ordinance or Regulation

Interactions between the ordinances and the environmental quality factors are represented by shadings in the matrix (Table 1), but are presented as separate entries in Appendix I-2, along with a numbered key. Recommended references are provided along with the discussions of each interaction; readers may obtain these studies to pursue the technical or legal ramifications that interest them.

Descriptions of Environmental Parameters

Air Pollution: Non-Point Sources

Residential activities are a major contributor to non-point source air pollution. The term "non-point sources" comes from mathematical modeling studies, which cannot treat buildings individually: instead, pollutants are assumed to be generated on an areawide basis by a particular land use. The main cause of air pollution from residential buildings is the burning of fuels for space heating; this can be reduced through stricter insulation requirements on new construction, inspection of boilers and incinerators, or provisions for shifts to cleaner fuels. Note that a shift to electric heating will reduce non-point source air pollution, but only at the cost of increased pollution and total energy use at central power plants (point sources).

Another source of air pollution from residential activities is the burning of leaves and other solid waste on individual lots.

Air Pollution: Mobile Sources

As the experience of Los Angeles and other cities show, air pollution from automobiles and other mobile sources can be extremely important, particularly for the production of photochemical smog. Local governments generally cannot set standards for vehicle emissions, but they do have control over subdivision plans, street layouts, and parking. As people drive fewer miles, pollution emissions are reduced: clustering to reduce street length and allow some mixed uses may reduce the amount of local auto travel; layouts may also be set up to aid mass transit, so that some auto trips can be completely eliminated; parking controls can be used to give people an incentive for carpooling, with a reduction in miles traveled (though not a total reduction: the car left home will be used for other trips).

Air Pollution: Point Sources

Point sources of air pollution include factories, mines, power plants, and other major fixed land uses. The main pollutants from such sources are sulfur oxides, particulates, and some toxic materials. While the main control on point sources comes from the Clean Air Act and is enforced by the states, local governments do have a role in controlling such pollution. Traditionally, this role involves smoke control ordinances, and limits on the composition of the fuels used locally. Odor control remains a local government responsibility. Zoning methods (e.g., emission density zoning) can be used to keep point source emissions within a zone at desired levels.

Water Quality: Non-point Sources

Runoff from developed and undeveloped lands is a major cause of poor water quality in rivers, streams, and lakes. Agricultural and urban runoff are sources of nutrients which cause eutrophication. Urban runoff also carries wastes of all sorts, in concentrations often worse than in sewage: biological wastes from animal feces and food; toxic metals from auto exhausts and from air pollution settling on the ground or carried by rains; acids; and so forth. The runoff from urban areas is heated (at least in summer) and can lead to large temperature changes in the streams and fish kills. Sedimentation and erosion, particularly from construction sites, is responsible for damming of streams, increased turbidity, fish kills, and poor drainage.

Water Quality: Point Sources

As with air pollution, the control of major point sources of water pollution is increasingly being regulated by the federal government. Local governments may include industry in treatment programs, but they do not have a major influence through the police power on the amounts or types of pollutants generated. Their only real concern comes through approving or denying zoning changes to polluting industries, and this is generally a minor role, particularly when compared to either federal programs, or local taxes and charges.

Water Quality: Groundwater

Groundwater is water contained beneath the surface. In many areas, groundwater is used for drinking directly; in others, it feeds ponds or rivers from which drinking water is drawn. Urbanization both reduces groundwater recharge and may pollute what recharge there is. Septic tanks are one source of groundwater pollution; sanitary landfills pollute ground and surface waters through leachate and runoff. Paving or building over land, which increases runoff at the expense of infiltration, reduces the amount of water entering the ground and may lower the water table. The materials picked up in urban areas, such as heavy metals or pesticides, may also pollute the groundwater: biological decomposition and cleaning occurs in the soils, but toxic wastes may not be removed. Another potential source of groundwater pollution is the use of disposal wells, particularly shallow ones.

Water Quantity: Flooding

Flooding is a natural phenomenon which has become an environmental problem becuase of the aggravating effects of development on the frequency and extent of floods. The economic damage of floods is well known--despite the construction since the 1930's of flood control reservoirs, dams, levees, and the like, flood damage has continuously risen. Damage to the environment has similarly risen, mostly due to the destruction of natural systems and erosion of soil associated with wider floodplains, but partly because of the impacts of inappropriately planned flood control engineering on natural water sources, and secondarily their tendency to encourage development in protected areas.

Water Quantity: Supply

The quality and quantity of drinking water supplies is generally a concern: whether the ground or surface water is clean, whether there is enough of it, and whether it will stay clean and sufficient for its intended uses. Local development activities can have an important impact on the level of the groundwater table, by obstruction of aquifer recharge areas; pollutants from developed land can contaminate the groundwater; and land activities on watersheds can affect surface water drinking sources.

Solid Waste

Solid waste disposal is predominantly a local environmental problem. Local governments control waste storage in the interests of public health: collection should be sanitary, quiet and odor free; disposal should not pollute the air or groundwater. Littering can introduce pollutants into the surface and groundwaters as well as be a health hazard and an esthetic nuisance.

Noise

Noise is more than a nuisance: it can be psychologically damaging, through the impairment of concentration and work effectiveness in everyday situations; it can impair hearing over the long term if ambient levels are excessive; it can be destructive of physical health in extreme cases, affecting many body functions. Noise is also destructive of wildlife habitat for certain species. Since elevated noise levels are generally an urban phenomenon, they are usually managed by local levels of government. (Exceptions include the regulation of noise of interstate carriers which is a federal function).

Esthetics/Wildlife

The effects of pollutants extend beyond public health and welfare issues and become involved in the "quality of life" issues of esthetics and wildlife preservation. Local governments have traditionally been concerned with such issues, primarily because of their impact on local economies, especially through property values. In this analysis, however, esthetics and wildlife is presented as a category of environmental impacts only to identify the ancillary impacts of controls aimed more specifically at residuals management. Sign ordinances and other controls aimed specifically at esthetic problem areas are not considered here, since they have no significant effect on residuals management. Where an ordinance (such as a tree preservation ordinance) has ancillary esthetic benefits, these are noted for reference.

Toxic Materials

In some states, toxic materials are under control of state regulatory bodies. The use of such materials also falls under EPA and OSHA standards. Local communities may have a say in the disposal of toxic materials, particularly in the choice of routes for shipment and in the choice of disposal sites. Toxic material disposal sites require careful management and design, and municipalities have a clear interest in their regulation.

Energy

Energy conservation is a national priority under the 1975 Energy Policy and onservation Act; states and local government are formulating plans to con-erve energy in a variety of areas, the most important being buildings and ransportation. While EPA has no legislative mandate in energy conservation, t has a strong interest in the pollution emissions reductions that accompany onservation measures. Local governments should be aware of the beneficial nteractions between energy conservation and local environmental quality.

Soil Loss

Erosion of soil represents an environmental problem, not only because it causes water quality problems, but because it may reduce agricultural production and diminish property values for many classes of land use. It has been estimated that it takes natural processes 600 years to generate one inch of soil, so large scale community soil loss is essentially irretrievable. Extreme forms of soil loss, such as landslides and the destruction of beach dunes, can be a threat to public safety as well as to property values. Local governments play the major role in controlling this problem.

Descriptions of Types of Ordinances

Zoning

General Districting of land into separate use zones may have limited positive environmental impacts if carefully done, but more often it has negative impacts due to its numerous side effects. The most common form of general districting for "environmental" purposes is large lot zoning, in which the rural character of land is expected to be preserved by one acre or larger lot sizes; health issues are also cited, such as the necessity for adequate lots for septic tank use or for continued reliance on wells for water supply. In fact, such zoning tends to destroy the natural appearance of land--as the district fills in, all but the very largest lots are fully landscaped and wildlife habitat is destroyed. Ultimately, development within the zone may have to be serviced with municipal utilities--at increased costs due to the dispersed layout.

The only form of conventional districting that can work effectively is the zoning of prime agricultural land into agricultural districts. This practice usually requires a number of supporting economic measures to be successful, however.

Sensitive Area Protection is a useful technique for local environmental planning. It generally involves the creation of overlay districts that further restrict permissible activities in existing use zones. The types of areas most commonly protected are wetlands, hillsides, aquifer recharge areas, streambanks, and woodlands. From the perspective of EPA legislative mandates, sensitive area protection is most useful in water resource protection. Other benefits are numerous, however, and include preservation of wildlife habitat, maintenance of ecological communities, flood protection, landslide protection, sedimentation and erosion control, recreation and esthetic benefits, and the use of vegetation as air pollution "sinks," or buffers. The major implementation problem of this established practice remains the taking issue: although courts increasingly recognize that sensitive area zoning protects the public health, welfare, and safety over the long term, individual landowners will context any unreasonable reduction on their potential return on their property.

Performance Zoning as defined here means the direct regulation of residuals discharge within specific zones. On the local level, the only practical performance zone seems to be set up by effluent allotment ordinances, in which the discharge of water pollution from sources such as "package plants" is controlled. Other performance zones are potentially useful for regulating major stationary sources of air pollution, such as in industrial areas; in the case of air pollution, however, regional planning for emissions allocations is desirable, as is done under the State Implementation Plans mandated by the Clean Air Act.

Flexible Zoning is a term that includes approaches such as Planned Unit Development, Cluster Subdivisions, Conditional Zoning, Floating Zones, and others. Common to all of them is the intention of getting away from rigid zoning patterns, allowing developers more flexibility in siting and design, and protecting environmental values through more sensitive adjustment of development to individual site conditions and the context of surrounding development. The immediate environmental benefits of these options lie in open space protection; indirect benefits are also gained in more efficient utility provision, and in air pollution and energy use reductions due to more compact designs. Flexible zoning approaches remain controversial since they depart from conventional marketing standards and can threaten values in adjoining properties. Of the several options, cluster subdivisions appear to have the greatest public acceptance; Planned Unit Developments, with their mix of land uses in previously single-purpose zones, are the most controversial.

Subdivision Regulations

Sanitary Sewage Requirements: Subdivision regulations always include requirements for sanitary sewage disposal, though primarily these serve to enforce the regulations of the local or state health department. The three basic options for subdivision developers--on-lot disposal (septic tanks), "package plants," and municipal sewage systems--are regulated by these requirements. From an environmental point of view, these requirements have both direct and indirect effects: the direct effects are on public health and on protection of groundwater resources from malfunctioning on-site disposal systems; the indirect effects are due to the implications of on-site disposal for lot layout and sizing. Sanitary sewage requirements are, therefore, of use as a measure both for improving wastewater disposal practices and for affecting community layout and infrastructure design. A major area for improvement in these regulations is their extension beyond immediate public health concerns into areas such as long range infrastructure and transportation planning, and long term programs for maintenance of on-site and package systems. See Section IV.

Stormwater Management: Stormwater management is often handled through the subdivision review process. Structural measures, conventionally limited to the the construction of stormsewers, are increasingly being extended in sophistication by the addition of requirements for on-site detention of runoff, and are simultaneously being complemented by more elaborate performance standards for disposal of runoff on site through structural (e.g., detention ponds), and non-structural measures (e.g., site design). See Chapter V.

Street Design: Subdivision regulations spell out requirements for the layout and design of streets. Environmental benefits due to improved street design are small, but potentially include reductions in vehicle trip length, coordination with municipal mass transit systems, and the use of streets as overflow channels for stormwater during intense storms.

Environmental Assessment Requirements: Some communities are attaching requirements for environmental assessments to their subdivision regulations or zoning ordinances. This process has great potential for insuring compatibility between site plans and the suitability of the land for development. It can consider a wide variety of environmental and other issues deemed to be important by the local community (as expressed by the zoning commission or planning board). See Chapter VIII.

Acquisition

Less-than-Fee Land Acquisition: Local powers of eminent domain can also be used, if necessary, to effect the purchase of limited rights to property. This approach is commonly used by conservation commissions, who acquire easements to protect scenic views and wildlife habitat, and by local governments that need to acquire rights-of-way across property for utility lines or roads. Easements generally expire after twenty-five to thirty years.

Land Banking: Eminent domain powers can be used to acquire permanent and complete rights to land to reserve it for public purposes. Alternatives to direct purchase exist that reduce the financial burden of this device on local communities. Land banking is generally used to reserve sites for buildings and landfills, and (less frequently) to protect sensitive areas (especially wetlands) from development. Land banking is an alterantive where either communities or courts decide that restrictive zoning measures on sensitive lands amount to an unreasonable taking of private property.

Codes

Construction, Building, and Health Codes: These three categories of locally enforced codes have direct or indirect effects on environmental quality factors. Construction codes can control the potentially severe impacts of construction activiries (noise, sanitation, erosion); building codes control performance of completed structures in areas such as thermal efficiency, and can permit the use of innovative technologies such as waterless toilets, solar energy collectors, etc.; health codes govern the continued fitness of the completed structure, and can be modified to take account of changes in environmental priorities (such as revoking permits for small apartment incinerators). At present, building codes seem to offer the most immediate opportunity for environmental improvements. See Sections III and IV.

Regulations/Ordinances

Flood Control Ordinances: The importance of local flood control ordinances is being eclipsed by the impact of the flood insurance provisions of the 1974 Housing and Urban Development Act, which require communities to undertake comprehensive floodplain management programs in exchange for continued federal insurance of loans on buildings constructed in floodplains. Previously, local restrictions of activities on floodplains were impeded by the taking issue. Opportunities for improving local flood control ordinances are essentially pre-empted by the HUD flood insurance program.

Sanitation Ordinances: These ordinances regulate the storage, collection, and disposal of solid wastes. They can also affect local materials recycling programs (glass, aluminum, ferrous metals). Solid waste management touches many environmental quality factors, including air pollution, water pollution, esthetics, public health, noise, energy use, and others. Opportunities for improvements in sanitation ordinances are numerous. See Section VII.

Tree Ordinances: Tree ordinances may affect the planting and preservation of trees throughout a community, but more generally they are aimed at the preservation of mature trees of native species along public and private rights-of way. Although tree ordinances theoretically have an impact on groundwater recharge, noise, and air pollution, their predominant effect is esthetic. In principle they are vulnerable to legal challenge, but in fact they never are contested because their effect on property values is positive and costs of compliance are usually negligible.

Burning Ordinances: Control of household burning of wastes by special ordinances is commonplace. Benefits accrue in air pollution abatement, odor control, and public safety. Opportunities for improvements to conventional burning restrictions are minimal.

Parking Ordinances: Parking ordinances have potential value for environmental management in two areas--air pollution abatement and stormwater management. Bans on parking can be implemented to reduce vehicle travel and thus air pollution emission; they can also be used to clear streets for more effective street sweeping, which can significantly reduce pollutant loadings in stormwater. Parking bans for air pollution control are more appropriately implemented in central urban areas, but for street sweeping purposes they are effective anywhere. See Section II.

Noise Control Ordinances: Noise control on the local level can involve controls both on production and reception of noise. Noise ordinances are generally enforced by the police, and have traditionally involved only nuisance noises. Current trends in noise control are toward comprehensive programs to abate chronic noise levels as well as occasional nuisances; control options may, therefore, appropriately be dispersed under zoning, building codes, and state laws (regulating vehicle noise levels, for example). Improvements in local noise control programs can yield significant environmental benefits. See Chapter VI.

Erosion and Sedimentation Control Ordinances: These ordinances are generally enacted to control construction activities. They can specify exact construction practices that minimize soil losses while sites are stripped, or they can set performance goals and allow earth movers to select from a "catalog" of acceptable measures in order to meet them. Usually adopted as a separate ordinance, erosion and sedimentation controls are most effective when they involve a permit process, administered by a variety of personnel or departments. There is considerable room for improvements in the design and application of these ordinances in most communities, especially those outside of states which have state-level erosion and sedimentation control programs. See Chapter V.

Runoff Control Ordinances: Runoff Control Ordinances are a counterpart to erosion and sedimentation controls, and are concerned with limiting the rate of runoff from completed projects. Methods to limit runoff over the long term are generally left to developers discretion, although the net result must be compliance with a stated standard. Increasingly common are performance standards which limit the rate of runoff after project completion to that characteristic of the same site in its natural state. These ordinances are also appropriately implemented as part of a zoning or subdivision ordinance. See Chapter V.

SECTION II

TRANSPORTATION AND PARKING MANAGEMENT

ENVIRONMENTAL IMPACTS

Automobiles are the source of large quantities of pollutants, which enter both the air and the water. In many Air Quality Control Regions, vehicle emissions of oxidants or carbon monoxide will continue to exceed national primary standards for many years to come. Since the primary standards are necessary for health reasons, this is an important problem affecting many urban areas. Similarly, the pollution caused by urban storm runoff adds metals and toxic materials to the streams, and many of these pollutants result from auto use.

Auto emission controls and increases in miles per gallon can help a great deal. However, automobiles cannot be made completely clean, and in some areas the only way to meet standards may be to reduce auto use. Under any foreseeable set of emission controls, standards will still be violated and the health and welfare of the people affected. (see Table 2) There are several approaches for this reduction, and they generally require providing some acceptable alternative, such as improved mass transit, car pooling incentives, high tolls, priority lanes for buses, and similar approaches. All of these can be provided, and they will induce some people to shift from auto commuting to other modes, with a resulting reduction in total emissions, related to the reduced vehicle miles travelled (VMT).

Table 2

Air Pollution Vehicle Controls and Air Quality[1]

Pollutant	Light Duty Vehicle Emission Standard grams/mile	% Improvement Base Year to 1990	% of Areas With 1990 Air Quality Violation
Carbon Monoxide	15.0	76	11
	9.0	80	0
	3.4	83	0
Oxidants	1.5	36	86
	0.9	40	86
	0.4	42	81
Nitrogen Dioxide	3.1	-29	43
	2.0	-17	38
	1.5	[redacted]	38
	1.0	- 7	38
	0.4	0	29

In general, the commuter only pays a portion of the real costs of auto commuting. He does not have to pay the social costs of air pollution, noise or other external effects, and many of the streets and highways are funded by property owners rather than auto users. Besides providing incentives toward other modes, then, it is also reasonable to attempt to make the commuter pay for the true costs of commuting.

One way to do this is through parking management, and it is one of the few options available to local governments. Most other solutions, like carpool programs, mass transit, or auto-free zones, are planned at the regional level and may be implemented there. A few, such as increased gas taxes or reduced speed limits, are options for the state and federal governments. Local options are, therefore, reduced to various forms of parking control as a method for capturing the true costs to their residents of excessive auto use.

Parking management methods which reduce VMT will have a direct impact on air pollution, by reducing the emissions proportionally. The impact of parking on water pollution is a bit more complex. First, automobiles emit lead and other toxic materials into the air, and some of these materials settle onto the ground as fine particules. Others are washed out of the air when it rains. These fine particles combine with other street waste (litter, animal wastes, etc.) and enter the storm drainage system and, eventually, the waters. Table 3 shows that they are often much stronger than the equivalent effluent from a secondary treatment plant, particularly for metals such as lead and zinc. A reduction in auto use will mean reduced pollution entering the waters, just as it also reduces pollution entering the air. Equally important, though, is that cars interfere with one of the best methods for cleaning up the street waste--street cleaning. Parking controls combined with an effective street cleaning program can greatly reduce the amount of pollution entering the water. In one EPA study,[3] it was estimated that broom sweepers remove 56% of the dirt and dust, 44% of heavy metals, and 37% of the BOD on the streets, when used efficiently. Vacuum sweepers potentially have higher removal efficiencies, and are being studied.[4] While sweepers are less effective on the fine particles from autos than they are on larger dirt, leaves, and litter, they are important in this phase of reducing water pollution.[5]

Table 3

Street Runoff Compared to Treatment Plant Effluent[2]

	Impact Ratio
Suspended Solids	104.00*
BOD	0.41
COD	6.70
Kjeldahl-N	0.13
Phosphate	0.22
Lead	1015.00
Zinc	47.00
Copper	9.80
Nickel	45.00
Chromium	18.00

*This ratio means there are over one-hundred times as much suspended solids in an average storm than in secondary treatment effluent in the same period, and serving the same area.

Thus, parking management by local communities can reduce both air and water pollution, through two general approaches. The first is to reduce total VMT, which will reduce the emissions which cause much of the air pollution, and associated water pollution. The second is to make the job of street cleaning easier, which will further reduce the important water pollution from urban runoff. The sections below describe the types of parking management, their costs and effectiveness, and the ways they have been implemented.

TYPES OF PARKING CONTROLS

Zoning Controls and Facility Review

Most zoning and subdivision controls provide for minimum levels of parking for each type of development, just as they provide for street sizes, sidewalks, and frontages. As long as people travel by car, it has generally been assumed that there should be enough parking to minimize congestion, insure the free flow of traffic, and avoid disrupting the neighborhood with cars trying to park. These objectives encourage total dependence on auto use. Table 4 shows a set of typical requirements for levels of off-street parking for various uses.

Table 4

Typical Parking Requirements[6]

Land Use	Parking Requirements
Commercial	
Office Buildings	1 space per 300 sq. ft.
Retail Service	1 space per 200 sq. ft.
Restaurants	1 space per four seats
Hotels, Motels	1 space per guest room; 1 space per employee
Medical-Dental	1 space per 200 sq. ft. (3 spaces per doctor)
Hospitals	1.3 space per bed
Industrial	
Manufacturing	1 space per 2 employees
Industrial Park	1 space per 2 employees
Wholesale and warehouse	1 space per 3000 sq. ft.
Educational	
High School	5 spaces per classroom
Public Buildings	
Auditorium	1 space per 4 seats
Museums, Libraries	1 space per 300 sq. ft.
Churches	1 space per 5 seats
Public Utilities	1 space per 300 sq. ft.
Residential	
Single Family, Apartments	1 space per dwelling unit
Dormitories	1 space per 2 occupants

However, many cities have seen increasing congestion and have encouraged a shift to mass transit to reduce air pollution and improve pedestrian access to the city. Therefore, where transit is available, it may be reasonable to set maximum levels for parking, and to require review of all major parking facilities.[7] Zoning controls would set minimum and maximum standards on parking for new construction, and could be fairly simple. Facility reviews would be more complex, since they would have to consider the full impact of the new parking facilities on traffic, air pollution, and land use. Still, both are methods for local government to use to manage new parking, and both allow careful balancing of environmental, economic and social considerations. Facility review adds easy control of parking garages, but this can also be done through zoning.

Resident Permit Districts

A recent innovation in parking management has been the resident permit district.[8] In this system, on-street parking in residential areas is restricted to the people who live there, and outsiders are not allowed to park. In some cases, only long term parking is restricted, to allow shopping and other short trips. Provisions can also be made for visitors. Consider a central community which receives large numbers of commuters daily, many of whom park in residential areas near their jobs. A permit program can reduce such parking, giving commuters an incentive to leave their cars home. It also gives the residents enough parking, reducing congestion and making their problems easier. The result is a benefit to the local neighborhood and a reduction in air pollution. Table 5 gives information about the workings of the program set up in Washington, D.C.

Provision of Fringe Parking

While facility review and resident permit programs can be implemented in urban areas, suburban communities can also aid in air pollution reductions. Most procedures that make transit use easier will reduce auto use somewhat (though often only slightly), and the provision of fringe commuter parking is one approach. A fringe parking area with express bus service downtown is an effective means of mass transit: the community will be aiding its residents if it provides parking for park-and-ride use, and supports the use of express buses.[10] Conversion of lands next to freeway interchanges is especially attractive.

Conventional Controls

None of the methods listed above will work unless parking violations are enforced. Zoning limitations will be useless if on-street parking is not expensive to the violator. Resident permit districts can only work when the non-resident user must pay a high fine.[11]

Conventional parking controls involve metering, no parking zones, tow zones, and special day or hour limits on parking.[12] If effectively enforced with sufficient fines, they will clear most cars from the streets during the control periods.

Table 5

Resident Permit Parking Program--Washington, D.C.[9]

1. Hours of Enforcement: 7:00 am to 6:30 pm, Weekdays, except Holidays.

2. Areas Affected: The program is city-wide and will be implemented on a petition basis. All impacted areas will be served. A zone system will be established throughout the city and each impacted area within the zone will be signed to indicate the two-hour limit.

3. Availability of Stickers: Stickers can be obtained from the Department of Motor Vehicles. The cost is expected to be between five and ten dollars, and will cover the program's administrative costs. A sticker is only valid in the zone in which it has been issued and is not transferable.

4. Coverage of Out of Town Guests, Household Employees and Visitors: They will be subject to the two-hour restriction. However, the Director of the Department of Highways and Traffic is authorized to make provisions for the issuance of temporary parking permits. We are also considering exemption stickers for the handicapped and other hardship cases.

5. Enforcement: The restriction will be enforced by the Metropolitan Police Department using the standard method of marking tires and re-checking the tires at certain intervals during the day.

6. Students and Other Temporary Residents: They are elibible only if they can prove that they are actual zone residents and meet the District's requirements for vehicle registration.

7. Renewal: The stickers have to be renewed annually.

8. Alternatives for Non-resident Vehicles: We believe that the majority of these vehicles will be able to utilize our fringe parking program, the area-wide car pool program, and the improving bus system.

9. Joining the Program: Each area must submit a block by block petition containing signatures of the majority of households in each block.

The goal in controlling parking for street sweeping is to get all cars off the block-face to be swept before the sweeper arrives. This is done best when there is a regular schedule for sweeping (e.g., Tow Zone-No Parking Friday 9-11 AM) and where the sweeping follows that schedule every week. The goal is to remove illegally parked cars, while minimizing the burden on residents. This means that, where possible, street sweeping should take place during periods when few people would want to park on-street, and when traffic is light. If quiet equipment is available, and an overnight parking ban is accepted by the community, sweeping in the early morning hours may be the best choice. It is usually the best choice in commercial districts.

It is very important to inform the people of when areas are to be swept. With well-designed, regular routes, each block will be swept at about the same time each week. Thus, a two or three hour period will be sufficient to insure the sweeping gets done, and parking can be allowed for the rest of the day. Routes and no-parking-zones should cover only one side of the street on a particular day, to allow people to park on the other side. The goal is simply to get the cars out of the way when the sweeper arrives, and this is most likely when parkers are told when the streets will actually be swept. Strict enforcement of violations is also necessary, and towing is the only solution that gets the cars out of the way. Tow trucks can precede sweepers over the route, far enough ahead so they do not slow things down. Good routes, frequent signs, and towing will make efficient sweeping possible.

There are options even if a regular sweeping schedule is not met. Cambridge, Massachusetts, has printed temporary signs which are hung in areas to be swept two days before sweeping, saying "Tow Away Zone; No Parking (day of week) (time) This Side; for Street Sweeping." These signs are hung by one man, and are placed early enough so that people know the area will be swept and can make other plans. While Cambridge does not have a regular sweeping schedule covering the whole city, the carefully placed temporary signs have much the same effect, and allow for variations in areas swept because of holidays and other factors.[13]

IMPACTS AND COSTS OF CONTROLS

Air Pollution-Related Controls

The controls identified for reducing air pollution are facility reviews, zoning changes, resident parking permit systems, and increased enforcement. Added to these should be rate increases in public or private garages and at meters, since these are under local control.

Parking controls and other management methods have been studied in an analysis of the Washington, D.C. area. Three alternatives were analyzed, and two of them are significant here. The first was a "no control" case--what would happen to VMT and air pollution without parking management programs and other attempts to reduce auto use. The second included parking facility review, resident parking permits, limits on new spaces and price increases. In the most comprehensive alternative, zoning changes were made to guide development to areas where mass transit would be most effective, and park-and-ride systems included. The reductions related to the parking controls along (option 2 above) are shown in Table 6. Note that these reductions are applied against a base which already includes vehicle emission controls, a mass transit system, and several bus priority operations; the change in ambient pollution levels could easily be larger in other areas.

Table 6

Effectiveness of Parking Controls[15]

	1980	1993
Trip Reduction (Journey to Work)	1.7%	1.2%
Pollutant Reduction		
CO	0.8%	0.9%
Oxidants	1.5	1.8%
NO_2	.3%	0.2%

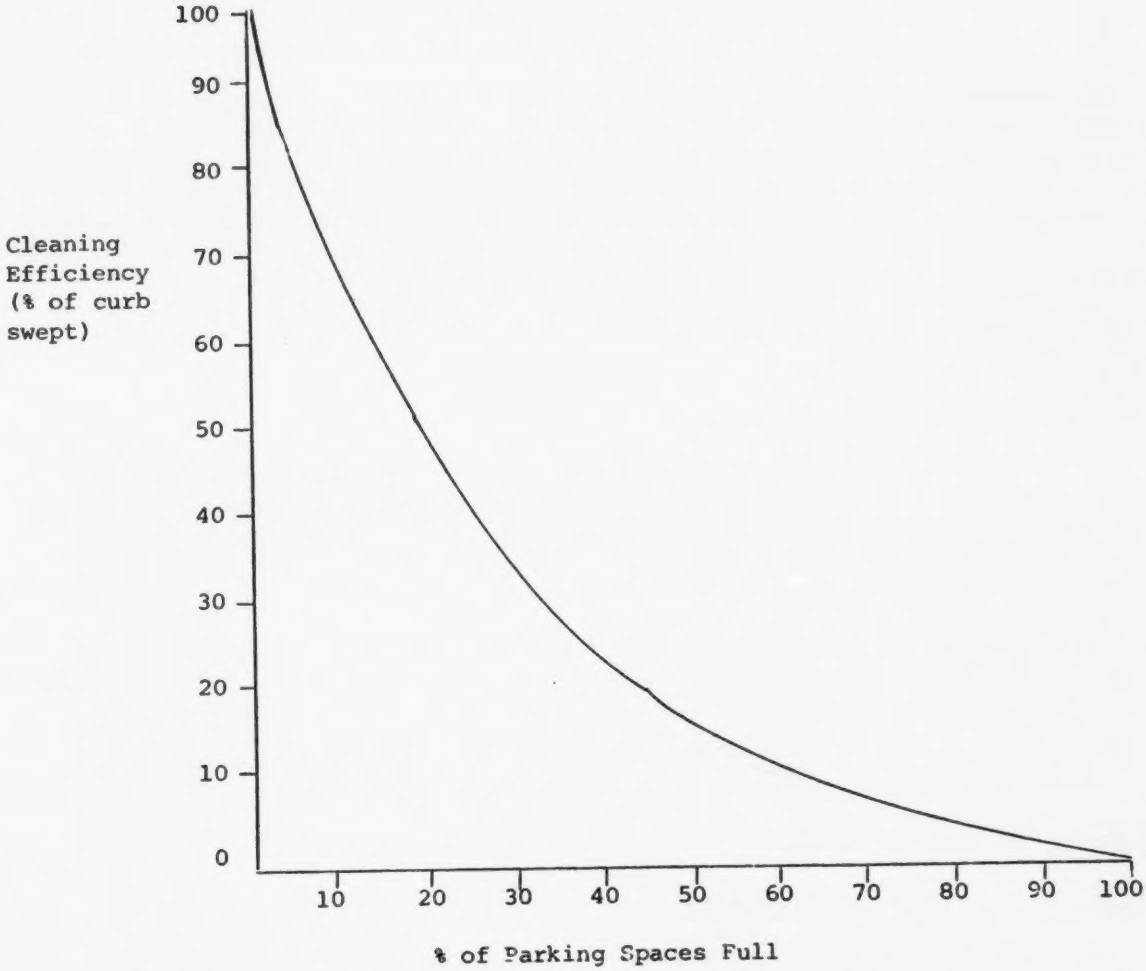
A fee increase of twenty-five percent on almost all garage parking spaces was implemented in San Francisco in 1970.[16] The largest effect was seen in increased parking garage revenues, but the number of cars parked was reduced somewhat. Commuters were more sensitive to increases than shoppers, probably because transit is a better alternative in the peak hours. The total effect, though, was slight: a twenty-five percent increase in fees led to only about a six percent reduction in commuter vehicles parked, and a four percent reduction in shoppers' vehicles. There is also no assurance that on-street parking did not increase, so these figures are the maximum likely reduction in travel. The quality of public transit will be of critical importance to this type of strategy.

One report on control strategies done at the Massachusetts Institute of Technology[17] identified an important side effect. Parking management increases carpooling and transit use, reducing the numbers of cars used for commuting, but the pool cars tend to be used for shopping and social trips; they will not, in general, stay in the garage all the time. Thus, the real VMT reduction is smaller than the direct change in commuting use.

The costs and feasibility of the various controls are acceptable. Table 7 gives the feasibility of parking controls as rated by a study for EPA. Permit programs and increased enforcement are generally self-supporting, with tickets paying for the people required to write them. A nominal permit fee to cover administrative costs is common--five dollars seems to be the average level.[18] Since resident permit fees benefit the local voters, they are usually easy to implement, though they may be subject to court conflicts. (See next section, Ordinances and Technical Data).

Figure 1

Effect of Parking on Curb Sweeping[21]



SOURCE: A.H. Levis, Urban Street Cleaning, Report No. EPA 670-2-75-030, February 1975.

Table 7

Feasibility of Parking Controls[19]

	Cost to Commuters	Cost to Government	Legal Power	Political Feasibility
Resident Permit	moderate	moderate	yes	easy
Parking Facility Review	low	moderate	questionable	easy

Facility reviews, zoning changes, and rate increases are subject to larger implementation problems. All three give people and businesses an incentive to go elsewhere. A business district without sufficient parking or with extraordinarily high rates will see its customers disappear to other shopping sites, unless excellent transit or amenities are offered. A community limiting parking without providing good alternatives may not get new businesses. Therefore, such changes should be implemented throughout the region (or, at least, in major centers) if possible. The cost of the facility review may also be high, but it can be included in a general environmental review process for the area (see Section VIII).

Water Pollution-Related Controls

As mentioned above, most parking controls can pay their own way through tickets, fees, etc. Thus, the cost of enforcement measures is small. Similarly, there are few implementation problems (beyond the first few weeks) in setting up parking controls for street sweeping. Public education is necessary for the affected areas, but this is simple and fairly inexpensive.

Therefore, the only major question is how much parking can affect street sweeping and lead to water quality improvements. In urban areas, most particles gather at the curb, so the fraction of the curb swept is most important.[20] Figure 1 shows the relationship between this measure and the parked cars, for an average block. As can easily be seen, a few cars will drop the sweeping effectiveness on a block considerably, so enforcement and parking controls are critical.

ORDINANCES AND TECHNICAL DATA

Facility Review and Zoning Controls

Two example facility review ordinances are contained in Appendices II-1 and II-2.[22] The first was developed as a draft by EPA for California cities and has not been implemented.

At this point, most parking management methods are voluntary. Thus, it is up to the local community to set what standards it desires for approving a facility, which may depend on the extent of the local automotive air pollution problem and other factors. Consistency with the Area Transportation Plans, however, would be desirable since it would insure that the regional context of parking limits is considered. The Seattle ordinance (Appendix II-2) was proposed as a good model for the type of ordinance which local governments could implement.

Resident Parking Permits

Appendix II-3 contains the Washington, D.C., permit ordinance, which is simply a small addition to existing parking procedures.[23] Other local governments, such as Cambridge, Massachusetts, Richmond, Virginia, Wilmington, Delaware, and Arlington County, Virginia, have implemented permit programs.[24] Local opposition has been slight. In Arlington, though, the ordinance was challenged in court, and the "classification based on address [was] struck down." The opposition came mostly from the federal employees who parked in the area, and the issue is still in litigation.[25] Special enabling legislation may be required for permit programs, so a good legal opinion would be useful.

Street Sweeping

The effectiveness of street sweepers is an important issue, particularly their effectiveness in removing fine particles which cause air pollution, particularly in the form of dust. Three major studies have been done of street runoff and how to control it and all are listed in the references.[26] The current APWA study analyzes the effectiveness of different types of sweepers and other controls. Previous sweeper evaluations[27] are outdated, particularly with respect to vacuum sweepers.

Appendix II-1

An Ordinance Providing for Parking Facility Review by Local Governmental Entities

Section 1 - DEFINITIONS

(1) "Parking Facility" (also called "facility") means any off-street area or space, lot, garage, building or structure, or combination or portion thereof, in or on which motor vehicles are parked.

(2) "Vehicle Trip" means a single movement by a motor vehicle that originates or terminates at a parking facility.

(3) "The phrase "Construction" means any physical alteration of the land upon which a new or modified parking facility is to be located including, but not limited to, site clearance, grading, dredging or land filling.

(4) The phrase "to commence construction" means to engage in a continuous program of physical alteration of the land upon which a new parking facility is to be located including, but not limited to, site clearance, grading, dredging, or land filling. For the purpose of this section, interruptions resulting from acts of God, strikes, litigation, or other matters beyond the control of the owner shall be disregarded in determining whether a construction or modification program is continuous.

(5) The phrase "to commence modification" means to engage in a continuous program of physical alteration of the land upon which a modification of an existing parking facility is to be located including, but not limited to site clearance, grading, dredging, or land filling.

Section 2 - APPLICABILITY

The requirements of this section are applicable to the following parking facilities within the _______________, the construction of which began after June 30, 1975.

(1) Any new parking facility with parking capacity for 250 or more vehicles;

(2) Any parking facility that will be modified to increase parking capacity by 250 or more motor vehicles; and

(3) Any parking facility constructed or modified in increments which individually are not subject to review under this section but which, when all such increments occurring on or after June 30, 1975 re added together, as a total, would subject the facility to review.

Section 3 - EXCEPTIONS

No person shall begin construction of any facility subject to this section without first obtaining written approval from the (Agency), provided that, this section shall not apply to (1) any parking facility where the owner or operator of such facility has "commenced construction" or has "commenced modification" of such facility on or before June 30, 1975, (2) to any parking facility constructed or operated together with a residential building or buildings for the primary use of residents of such building(s) (except that an apartment or condominium development with 1,000 or more spaces or an apartment or condominium to increase parking capacity by 500 or more vehicle spaces shall be required to obtain approval), (3) any parking facility to be constructed by a religious organization, and to be used, solely for religious purposes (not including high schools and college level education).

Section 4 - APPROVAL

Approval to construct or modify a facility shall be granted if the governing body determines that:

(1) The design or operation of the facility will not cause a violation of any regulations which are a part of the federally approved California Implementation Plan, and

(2) all requirements provided in Appendices to the EPA Parking Management Regulations promulgated for California have been met, and

(3) the facility is consistent with the provision of the 3-c agency transportation plan for the applicable area and with the regional parking management plan where one has been approved by the Administrator of EPA.

Section 5 - APPLICATIONS

Except to the extent that the (Agency) waives any such requirements in writing, all applications for approval under this section shall include the following information:

(1) Name and address of the applicant.

(2) Location and description of the parking facility.

(3) A proposed construction schedule.

(4) The normal hours of operation of the facility and the enterprises and activities that it serves.

(5) The total motor vehicle capacity before and after the construction or modification of the facility.

(6) The number of people using or engaging in any enterprises or activities that the facility will serve on a daily basis and a peak hour basis.

(7) A projection of the geographic areas in the community from which people and motor vehicles will be drawn to the facility. Such projection shall include data concerning the availability of mass transit from such areas.

(8) An estimate of the average and peak hour vehicle trip generation rates, before and after construction or modification of the facility.

(9) An estimate of the effect of the facility on traffic pattern and flow.

(10) An estimate of the net change in VMT resulting from the operation of the proposed facility.

(11) Additional information, plans, specifications or documents as required by the (Agency).

(12) For any parking facility having capacity for 1000 or more vehicles, additional information may be required by the (Agency).

(13) If the (Agency) specifically so requests, the application shall also include an analysis of the effect of the facility on site and regional air quality, including, where applicable, a showing that the facility will be consistent with the federally approved California Implementation Plan, and that the facility will not cause any national air quality standards to be exceeded within 10 years from date of application. The EPA Administrator may prescribe standardized screening techniques to be used in analyzing the effect of the facility on ambient air quality.

(14) Each application shall be signed by the owner or operator of the facility whose signature shall constitute an agreement that the facility shall be constructed in accordance with the information submitted in the application. In addition, the (Agency) may prescribe reasonable construction and operating conditions to any approval granted.

Section 6 - REVIEW PROCEDURES

(1) Within ____ days after receipt of an application or addition thereto, the (Agency) shall advise the owner or operator of any deficiency in the information submitted in support of the application. In the event of such a deficiency, the date of receipt of the application for the purpose of subparagraph (2) of this paragraph shall be the date on which the required information is received by the (Agency).

(2) Within ____ days after receipt of a complete application, the (Agency) will:

i. Consult with ____________ air pollution control agency which will determine the air quality impact of the proposed facility.

ii. Make a preliminary determination whether the parking facility should be approved, approved with conditions, or disapproved.

iii. Notify the public, by prominent advertisement in a newspaper of general circulation, of the opportunity for inspection and written public comment on the information submitted by the owner or operator and the (Agency's) preliminary determination of the approvability of the facility.

(3) A copy of the notice shall be sent to the applicant and to officials and agencies including Region IX, EPA, having cognizance over the location where the parking facility will be situated, as follows: State/Region/and/or local air pollution control agencies, the chief executive of the city and county; and any comprehensive regional land use or transportaton planning agency and to any person requesting such notification.

(4) Comments submitted in writing by the public and the applicant or postmarked within 30 days after the date such information is made available shall be considered by the (Agency) in making its final decision on the application and the (Agency) shall take final action on an application within ____ days after the close of the public comment period. Any of the time periods specified in this Section may be extended by no more than ____ days, or such other period as agreed to by the applicant and the (Agency).

(5) Approval to construct or modify shall become invalid if construction or modification is not commenced within 24 months after receipt of such approval. The (Agency) may extend such time period upon a satisfactory showing that an extension is justified. The applicant may apply for such an extension at the time of initial application or any time thereafter.

Section 7 - TRANSFERABILITY

Approvals are transferable between successive owners of property for which an approval is granted so long as the facility is constructed and/or modified in full accordance with the approved application and its conditions.

Section 8 - PENALTIES

Any owner or operator who fails to construct a parking facility in accordance with the application as approved by the (Agency); any owner or operator who fails to construct and operate a parking facility in accordance with conditions imposed by the (Agency); any owner or operator who modifies a parking facility in violation of conditions imposed by (Agency); any owner or operator of a parking facility subject to this section who begins construction thereof on or after July 1, 1975, without applying for and receiving approval hereunder, shall be guilty of a misdemeanor and shall be punished by a fine of not less than ________ dollars ____________ or by imprisonment in the City jail for not more than ___________ and may be restrained and enjoined from further violation of this ordinance.

Section 9 - EFFECTIVE DATE AND INCONSISTENCIES

This ordinance shall take effect and be enforced from and after its passage and publication according to law. Existing ordinances or parts thereof inconsistent with this ordinance are hereby repealed.

Passed by the ____________________________ (governing body) of

the ___________________ of ______________________ on ______________
19__.

(authorized signature)

(attest)

Appendix II-2

Rules and Regulations - Residential Permit Parking Program

By virtue of the authority vested in me as Mayor of the District of Columbia, the following objective criteria is hereby established to be used in evaluating need for restricted parking in a residential area in accordance with Section 82 (c) of Regulation 74-25:

For an area, however big or small, to be eligible for residential permit parking, that area must meet the following criteria:

(1) During any period between the hours of 7:00 a.m. and 6:30 p.m. weekdays, except holidays, the number of vehicles parking (or standing), legally or illegally, on the streets in the area is equal to 70% or more of the legal on-street parking capacity of the area. For purposes of this criterion, a legal parking space shall be 20 linear feet.

(2) During the same period as in Item 1 above, 10% or more of the vehicles parking (or standing) on the streets in the area are not registered in the name of a person residing in this area. For purposes of this criterion, the latest available information from the Department of Motor Vehicles regarding registration of motor vehicles shall be used.

(3) Prior to an area being recommended as a residential permit parking area, the following facotrs must be considered:

   (a) The clean air requirements of Federal and District air quality plans.

   (b) The possibility of a reduction in vehicle miles traveled.

   (c) The likelihood of alleviating traffic congestion, illegal parking, and related health and safety hazards.

   (d) The proximity of public transportation.

   (e) The desire and need of the area residents for residential permit parking and their willingness to bear the associated administrative costs.

(f) The need for parking for periods in excess of two hours for business establishments and the general public for religious, health, or education purposes; and

(g) The need for parking regulation to maintain the stability of neighborhoods.

Interested persons residing in impacted areas may submit written petitions reflecting the majority viewpoint on the program to Mr. Martin K. Schaller, Executive Secretary, Executive Office of the Mayor, Room 528, District Building, 14th and E Streets, N.W., Washington, D.C. 20004.

Walter E. Washington
Mayor

Appendix II-3

A Resolution Adopting an Interim Parking Policy for the Central Business District

Whereas A goal is that people of all income levels in the city must be able to move swiftly, safely, and economically from place of residence to place of work and together important destinations downtown and elsewhere, and to do so with minimum damage to the environment for living. This means that movement of people and goods must not severely damage the quality of areas for residential and other uses, and have minimum adverse impact on the quality of air and level of noise in the city; and

Whereas A second goal is that Seattle's downtown parking must support a useful, interesting, attractive, and healthy core for the metropolitan area, providing a strong employment and tax base for Seattle's citizens particularly; and

Whereas From these broad goals stem certain related objectives:

1. Pedestrians should be able to move about with ease and comfort in the core of the CBD, particularly with maximum freedom of conflict with vehicles.
2. The percentage of people coming to downtown by public transit, car pools and bicycles, especially for the daily work trip should be greatly increased.
3. More of the street right-of-way in many parts of the CBD should be devoted to pedestrians (wider sidewalks) and to transit operations (bus stops and preferential travel lanes).
4. Congestion resulting from undue searching for parking places should be reduced; the movement of automobiles from their arrival route to their destination in or near the CBD should be as direct as possible.
5. Service vehicles and goods-handling vehicle should be accommodated as needed to serve appropriate CBD land uses.

6. Air polluting emissions in the CBD should be positively influenced through City parking policy.

7. The CBD should maintain its dominant metropolitan center position. This implies an increase in CBD employment commensurate with regional growth, a significant increase in the number of people living in the CBD or within one-half mile of it, and maintenance of strong retail activity in the area.

Be It Resolved by the City Council of the City of Seattle, the Mayor Concurring.

That the following policies shall guide city action concerning parking and transportation in the CBD.

1. No changes will be made in current parking practices in the CBD prior to the development of workable alternatives, and implementation of these policies will take place gradually and in full consultation with interested citizens, downtown property owners, businesses, investors and dwellers to assure the adoption of workable policies.

2. No action to alter existing mobility or parking patterns will be taken without the specific provision of new alternatives to accommodate present and expected levels of travel.

3. The City of Seattle will work with individual CBD businesses to promote car pools and transit usage as reasonable and low-cost alternatives to driving and parking private autos.

4. A substantial portion of future CBD-oriented long-term parking spaces should be located at a number of outlying mass transit nodes (both inside and outside the city limits) to intercept people destined for downtown. Each park-ride lot should be connected to the CBD by express transit at peak travel hours and by very high quality service at other hours.

   This policy is exemplified in the present Blue Streak type operation which is scheduled to be expanded to include approximately 50 new park-ride lots with a combined capacity to park 16,000 vehicles, all to be constructed under Metro through 1980. Carrying out such a policy (expanded in scope to meet demand) will:

(1) assist in keeping travel on arterials leading to the CBD at an acceptable level; (2) serve to free-up parking currently devoted to long-term use for greater short-term use; and (3) generally absorb the increased demand for provision of additional long-term parking spaces for downtown resulting from increasing CBD employment.

5. Outlying parking facilities should be developed with a "low profile;" that is, each area should be kept reasonably small, with substantial boundary screening and internal planting to minimize adverse impacts on the surrounding areas.

   This policy is intended to keep the scattered, outlying parking facilities compatible with their surroundings. It is assumed that land values and zoning height limits will dictate open lots or, at most, a double deck lot.

6. The periphery or "CBD frame," as shown on the attached maps, should gradually evolve to provide nearly all of the remaining CBD-oriented long-term parking not able to utilize the outlying park-ride lots referred to in Policy 4. The implementation of this policy should be keyed to the availability of rapid and convenient access between the CBD frame and principal core destinations.

   The intent here is to establish a "sieve" which will retain at the edge of the CBD as many of the cars as possible which somehow cannot fit into the park-ride scheme described in Policy 4 above, and that access from the periphery shall be provided to ultimate principal CBD destinations.

7. The CBD peripheral parking facilities should be related as closely as possible to the arterial ways used by the vehicles in approaching and leaving the CBD. These parking facilities, for example, should be closely related to the on- and off-ramps of Highway I-5 and Alaskan Way Viaduct and to other principal access routes.

   This policy seeks to ease the travel load on downtown streets.

8. The CBD peripheral parking facilities should be tied to the principal CBD people-destinations by the easiest, most direct

routes. Weather protection and pedestrian assist systems, such as moving sidewalks or escalators, should be used when feasible.

This policy recognizes the need for speedy and comfortable people-movement in order to induce people to leave their automobiles in peripheral locations.

9. Parking located within the CBD core should be limited approximately to the number of spaces that now exist. The location of these might be reordered considerably within the area. The character of core parking should also gradually change from long-term to short-term use where walking distance is not excessive or where rapid and convenient access becomes available from parking on the periphery.

   This policy means that replacement parking facilities, either as principal or accessory uses, could be provided as presently existing parking is displaced by new buildings. It also recognizes that a certain amount of interspersed parking is necessary for the healthy functioning of some core uses, e.g., parking for hotel guests, for the physically handicapped, for some types of customers and building tenants, etc. It also recognizes that, if the CBD core is to be a predominantly pedestrian precinct, the amount of parking, the number of driveways, the number of moving vehicles, etc., should be minimized. It is assumed that all off-street parking in the core will ultimately be in multi-level structures and that most of it will be closely tied to other specific uses and available only because of that tie, e.g., accessory to an office building.

10. To the greatest extent possible, parking in and near the CBD core should incorporate joint development. At least at street level there should be emphasis on human scale and character such as is manifested through retail sales and service and displays. Housing, hotels, offices, etc. should utilize air rights over parking facilities. Locations should be selected to serve both daytime and nighttime activities during both work week and weekend periods.

    This policy is responsive to the popular demand to keep people-use dominant over vehicle-use in the CBD. It does this in part by increasing the efficiency with which a limited amount of parking can serve the need, and in part by integrating the parking with pedestrian-type uses.

11. To improve the aesthetics of downtown, minimum standards for parking lot improvement should be established and vigorously enforced in the CBD. The period for conformance should be reasonably short, and some of the requirements should apply to upgrading existing lots.

    This recognizes that there may be open-lot parking in the CBD . It does this in part by increasing the efficiency with which a limited amount of parking can serve the need, and in part by integrating the parking with pedestrian-type uses.

12. No new long-term parking should be established in over-the-water locations along the Central Waterfront, and such existing parking should be phased out from these locations over a reasonable period of time where possible.

    This policy would tend to minimize conflict between automobiles and the growing pedes-rian activity along the recreation-oriented waterfront. It is also in general support of the Shoreline Protection Act.

13. Incentives, economic and otherwise, shall be explored to achieve the above mentioned goals, objectives, and policies.

Conclusion

The intent of this policy is to provide a basis for a program which, implemented over a period of years, will bring parking into its proper role as a part of the transportation system. Private parking facilities, particularly open lots, tend to be impermanent, and firm guidance at this time can result in accomplishment of goals and objectives. The carrying out of policies, over a period of years, should render little harm to private owners or business managers.

FOOTNOTES

1. Environmental Protection Agency and Federal Energy Administration. Summary Paper on Fuel Economy; Impact of Alternative Auto Emission Standards. February 1976.

2. D.G. Shaheen. Contributions of Urban Roadway Usage to Water Pollution. EPA 600/2-75-004, April 1975.

3. J.D. Sartor and G.B. Boyd. Water Pollution Aspects of Street Surface Contaminants. EPA-R2-72-081, November 1972.

4. Richard Sullivan, American Public Works Association, personal communication, March 1976.

5. Sartor and Boyd. op.cit.

6. C.T. McGavin. Municipal Codes and Parking Management. Applied Parking Techniques, Inc., for U.S. Environmental Protection Agency, 1975.

   D.K. Witheford and G.E. Kanaan. Zoning, Parking and Traffic. Naugatuck, Connecticut: Eno Foundation for Transportation, 1972.

7. E. Twomey. "Preliminary Report: Relationship Between Parking Management and Vehicle Miles Traveled." U.S. Environmental Protection Agency, 1975 (DRAFT).

8. Cities having such programs include, at a minimum, Cambridge, Massachusetts; Wilmington, Delaware; Richmond, Virginia; and Washington, D.C.; Arlington County, Virginia, is in litigation.

9. See Appendix II-1.

10. H.S. Levinson; C.L. Adams; and W.F. Hoey. Bus Use of Highways, Planning and Design Guidelines. National Cooperative Highway Research Program, Report 155, Washington: Transportation Research Board, 1975.

11. In Cambridge, for example, illegal on-street parking outside tow zones carries a minimum fine of $15 in residential areas, and $5 elsewhere.

12. McGavin. op.cit., and Witheford & Kanaan. op.cit.

13. Department of Traffic and Parking, and Department of Sanitation, Cambridge, Massachusetts.

14. Energy and Environmental Analysis. Parking Management Study of the Washington, D.C. Region. Draft final report for U.S. Environmental Protection Agency, 1975.

15. ibid.

16. D. Kulash. "Parking Taxes as Roadway Prices: A Case Study of the San Francisco Experience." *Transportation Research Record #494*. Washington: Transportation Research Board, 1974.

17. T. Adler. *A Joint Choice Disaggregate Model of Non-Work Urban Passenger Travel Demand*. Unpublished M.S. Thesis, Department of Civil Engineering, MIT, 1975.

18. $5 is used by Cambridge and Washington, at least.

19. Energy and Environmental Analysis, Inc. *op.cit.*

20. L.T. DeStefano and A.H. Levis. "A Model for the Effect of Illegally Parked Cars on Street Cleaning." *Journal of Environmental Systems*, 2(2):109-129 (June 1972).

21. *ibid.*

22. See Appendix for ordinances

23. See Appendix for ordinances

24. E. Twomey, EPA, personal communication.

25. C. Flynn, County Attorney, Arlington, Virginia, personal communication.

26. Shaheen, *op.cit.*; Sartor and Boyd, *op.cit.*; Sullivan, *op.cit.*

27. W. Laird and K. Scott. "How Street Sweepers Perform Today." *The American City* 86(3): 58-62 (March 1971).

SECTION III

SPACE HEATING AND HOME ENERGY CONSUMPTION

ENVIRONMENTAL IMPACTS OF SPACE HEATING

Space heating in residential and commercial buildings accounts for approximately eighteen percent of the nation's energy use overall, and about seventy percent of homes in the United States contain either central heating, or built-in devices that deliver heat to each room.[1] Except for the limited energy produced by hydroelectric, geothermal, and nuclear plants, all energy used by space heating equipment comes, directly or indirectly, from the burning of fossil fuels; the combustion of these fuels results in air pollution, and, to a much lesser extent, water pollution and solid waste generation.

Energy Conservation

In order to reduce pollution caused by the burning of fossil fuels, one can either attempt to clean up the emissions from the burning or reduce the amount of fuel burned. The first solution is impractical where many homes or commercial furnaces are concerned, but it is effective at central power plants. A more efficient and cheaper solution is to reduce the consumption of energy for space hearing by promoting more energy efficient building practices. Because of the rising costs of fossil fuels world-wide, programs to increase energy conservation already have high priority; reduction in environmental pollution is but one of several beneficial effects of such programs.

To arrive at some estimation of how much pollution emissions can be reduced by various local regulations of building practices, a number of assumptions must be made about the impact of revised standards on energy consumption. Although a variety of programs are possible, improving insulation standards in new and old buildings is the most effective single approach. Turning down thermostats and improving the efficiency of furnaces (through adjustments ahd maintenance), while cheaper to implement, do not achieve comparable levels of conservation.

Table 8 shows the percentage of energy savings possible by implementation of basic improvements in insulation and heating plants.[2] These are general figures, but they are sufficiently accurate for estimating average savings for characteristic dwellings. From the table it is clear that the total savings available from improving insulation (the first three construction measures) are significantly greater than those from improving equipment performance standards--42.5 percent versus 13 percent, or more than three times as great. Furthermore, requiring improved insulation of new buildings is a strategy that local governments can implement through their own building codes; raising

Table 8

Percentage Heating and Cooling Energy Consumption Savings for New Construction Measures in Residential and Commercial Buildings

New Construction Measures	Percent Annual Heating Energy Saved		Percent Annual Cooling Energy Saved	
	Residential	Commercial	Residential	Commercial
Increased Wall, ceiling, floor insulation	20	15	4	--
Double glazing, storm windows and doors	17	20	--	--
Improved caulking and weatherstripping	11*	11*	8*	8*
Minimum equipment performance standards	13	6	10	10

Sources: Hittman Associates, Inc., and

(1) "The Potential for Energy Conservation in the Residential and Commercial Sectors," A.D. Little, Inc., for the Council on Environmental Quality, July 1974.

(2) "Residential Energy Consumption - Multifamily Housing," Hittman Associates, Inc., for the Department of Housing and Urban Development, January 1974.

(3) "Impact of Improved Thermal Performance in Conserving Energy, National Mineral Wool Insulation Associations, Inc., April 1972.

*Where storm windows and doors are installed, the value of improved caulking and weatherstripping is reduced by 50%.

equipment performance standards is a strategy more appropriate on the state or federal level, due to the necessity to implement it on a large scale basis in order to allow manufacturers to comply.

Assuming, then, that the stated percentage savings available from improved insulation are attainable, it is necessary to apply these savings to characteristic dwelling units in various climates to arrive at actual fuel saved. In various reports to the Environmental Protection Agency and the Department of Housing and Urban Development, Hittman Associates has used the energy consumption parameters of statistically typical residences in the Baltimore, Maryland, area.[3] Within limits, it is possible to assume that the heating requirements of these units in climates elsewhere in the country are proportional to changes in the total annual number of heating degree-days.[4] (A heating degree-day is calculated by subtracting the mean daily temperature during the heating season from 65°F or some other base; total annual degree days are the sum of the individual heating degree-days over a year.) Figure 2 shows the distribution of heating degree-days across the United States. Other factors besides degree-days, such as humidity, wind velocity, building orientation, and consumer habits are also important in determining heating requirements, but until further data is developed, the most useful estimations are found by assuming direct proportionality between heating degree-days and energy consumption of a given design of house.

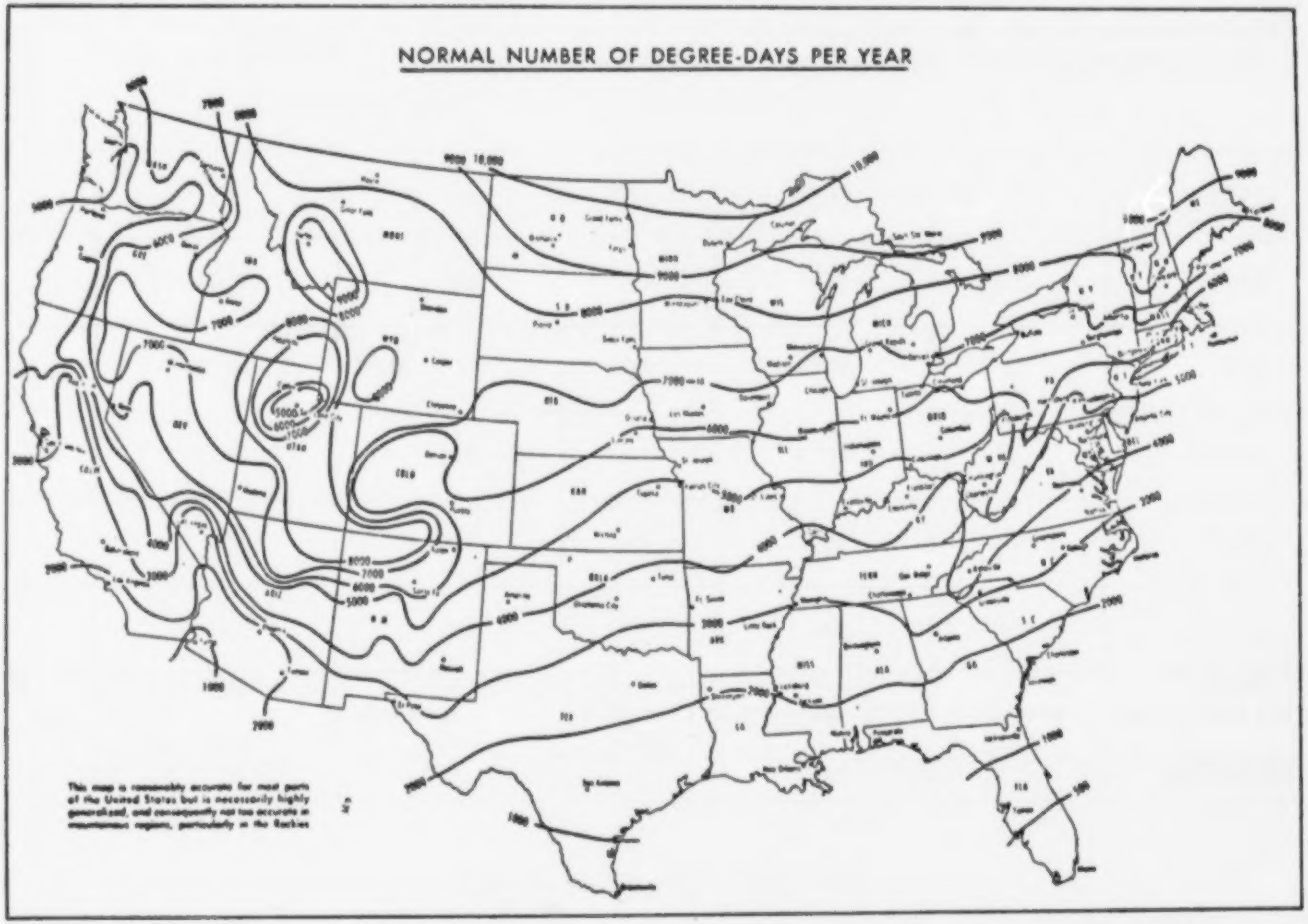
Table 9 shows the approximate heating requirements for the characteristic single family house (1695 square feet; three bedrooms, one bath: see Appendix III-1 for full description) in various climates. These heating requirements are translated into fuel and electricity consumption using heating efficiencies for gas of seventy-five percent; oil, sixty-three percent; and electricity, ninety-five percent;[5] and heating contents of fuels from the Federal Energy Administration, "Monthly Energy Review."[6] (For a discussion of what these savings mean in dollars see "Retrofitting Existing Construction" in this chapter.) It should be stressed that the apparent high rate of efficiency of electrical energy conversion applies only within a building; it deals only with the conversion of electricity to heat, not the conversion of fuel to electricity. Conversion of fuels to electric energy is discussed below.

Air Pollution

Natural gas and distillate fuel oil are the primary fuels burned in furnaces in homes and commercial buildings. Propane, butane and other liquified petroleum gases are also used, comprising about ten percent of gas burning systems.[7] (Some coal and wood burning furnaces continue in use in some sections of the country, but their impact overall is negligible.) The primary waste products of this fuel combustion are particulate matter, oxides of nitrogen (NOx), and oxides of sulfur (SOx), though other pollutants are contributed as well.

But fuel burned in furnaces is not the only source of air pollution related to space heating. In 1970, about 4.9 million homes were heated by electricity,[8] the majority using electrical resistance heating and about ten percent relying on (much more efficient) heat pumps. Electrical resistance heating is highly

Figure 2



NORMAL NUMBER OF DEGREE-DAYS PER YEAR

1000
2000
3000
4000
5000
6000
7000
8000
9000
10,000

This map is reasonably accurate for most parts of the United States but is necessarily highly generalized, and consequently not too accurate in mountainous regions, particularly in the Rockies

Source: C. Strock, and R.L. Koval, Handbook of Air Conditioning, Heating, and Ventilating, Industrial Press, Inc., New York, New York.

Table 9

Approximate Heating Requirements for the Characteristic Single Family House Under Different Climatic Conditions

Degree Days	Basic Heating Load of Characteristic House (THERMS)*	GAS (x1000 ft^3)		OIL (gallons)		ELECTRICITY (kwhr)	
		Characteristic House	With Improved Insulation	Characteristic House	With Improved Insulation	Characteristic House	With Improved Insulation
3000	685	89	61	784	541	21133	14577
4000	915	118	82	1046	723	28229	19472
** 5000	1140	148	86	1305	757	35170	20399
6000	1370	177	103	1568	909	42266	24514
7000	1600	207	120	1831	1062	49361	28360
8000	1825	236	137	2089	1211	56303	32656

*1 THERM = 10^5 BTU.

**1000-4500 -- Increased insulation, improved caulking and weatherstripping.
4500-10,000 -- Increased insulation, improved caulking and weatherstripping, and storm doors/windows or double glazing.

REFERENCE: Hittman Associates, Title X EIS, p. 5,7.

inefficient systemwide compared to burning oil or gas in the home: electricity requires about twice as much fuel per BTU of heat delivered. This fuel is burned at central power plants, so all associated air pollution emissions are emitted at a concentrated point. And, power plants tend to use dirty fuels (such as residual fuel oil and coal) compared to home heating plants, so their emissions tend to have a high environmental impact.

Table 10 shows the potential emissions reductions attributable to improved insulation in homes in various parts of the country. The savings in fuel and energy use are converted to savings in air pollution emissions by the use of constants derived by Hittman Associates.[9] The conversion efficiency of power plants is taken from FEA figures.[10] To provide a realistic scale for improved insulation practices community-wide, figures are expressed in tons of pollutants per year per thousand houses. The table clearly shows the substantial emission reductions attributable to improved insulation for dirtier fuels, and colder climates. While these are annual figures, the largest fraction of these emissions occur over the peak of the heating season in January and February, with consequently greater impacts on local air quality during these months.

Similar calculations may be performed for other popular small-scale housing, such as attached townhouses and garden apartments. In the case of large scale dwelling complexes, such as high-rise apartment houses, insulation standards are already likely to be higher than for single-family dwellings, since potential buyers in this sector tend to be more conscious of life-cycle operations and maintenance expenses when they invest. The figures in Tables 11 and 12 are based on characteristic performance standards developed for townhouses and low-rise apartment structures by Hittman Associates,[11] and are related to typical blocks of units--six townhouses, twenty-four low-rise apartments. Potential savings were estimated to be roughly the same for townhouses as for single-family dwellings on a percentage basis, and to be about two-thirds as great for low-rise apartments. As both of these configurations are fundamentally more efficient to heat in the first place than single-family dwellings, so their savings available per unit are also lower.

Relating these emissions of pollutants to actual ambient air quality is a complex problem. It depends on many factors, such as the distribution of sources (the density of development), meteorological factors, and local topography. All other sources of air pollution must be considered in any modeling effort. The air quality improvement accruing to more efficient space heating of homes may be a minor factor in many heavily developed areas, where heavy air pollution emissions come from automobiles and industry. The air pollution reductions attributable to improved insulation are, however, such a substantial proportion (about forty percent) of the total contributed by the housing sector that the improvements described here could have a substantial effect on air quality if conscientiously implemented throughout a local community. Since implementation of this program will result in substantial savings to homeowners within a relatively short time (see "Retrofitting Existing Construction" below), there is no net cost to the community associated with it.

Table 10

Approximate Air Pollution Emission Reductions Due to Improved Insulation of Single Family Houses

UNITS: tons/year/1000 houses

Degree Days	Particulates			Nitrogen Oxides			Sulfur Oxides			Hydrocarbons			Carbon Monoxide			Aldehydes		
	Gas	Oil	Elec.	Gas	Oil	Elec.	Gas	Oil	Elec.	Gas	Oil	Elec.	Gas	Oil	Elec.	Gas	Oil	Elec.
3000	.3	1.2	2.4	.7	1.5	25	.8	3.8	44	.1	.4	.4	.3	.6	1.4	.1	.2	.007
4000	.4	1.6	3.2	.9	2.0	33	1.1	5.1	59	.2	.5	.6	.4	.8	1.8	.2	.3	.009
5000	.6	2.7	5.4	1.5	3.3	56	1.8	8.6	99	.3	.8	.9	.6	1.4	3.1	.3	.6	.015
6000	.7	3.3	6.5	1.8	4.0	67	2.2	10.3	119	.3	1.0	1.1	.7	1.6	3.7	.4	.7	.018
7000	.8	4.0	7.7	2.2	4.6	79	2.5	12.1	140	.4	1.2	1.3	.9	1.9	4.4	.4	.8	.022
8000	.9	4.6	8.6	2.5	5.3	89	2.9	13.9	158	.4	1.3	1.5	1.0	2.2	4.9	.5	.9	.025

Table 11

Net Air Pollution Emission Reductions for a Block of Characteristic Townhouses (6 dwelling units) With Improved Insulation (tons x 10^{-3}/year)

GAS HEAT

Degree Days	Particulates	Nitrogen Oxides	Sulfur Oxides	Hydro-Carbon	Carbon Monoxide	Aldehydes
2000	1.14	2.97	.035	.48	1.2	.59
3000	1.71	4.45	.053	.72	1.8	.89
4000	2.33	6.08	.072	.99	2.5	1.22
5000	2.90	7.56	.089	1.23	3.1	1.51
6000	3.47	9.05	.011	1.47	3.7	1.81
7000	4.04	10.50	.012	1.71	4.3	2.11
8000	4.61	12.00	.142	1.95	4.9	2.40

OIL HEAT

Degree Days	Particulates	Nitrogen Oxides	Sulfur Oxides	Hydro-Carbon	Carbon Monoxide	Aldehydes
2000	4.88	5.86	15.3	1.46	2.44	.977
3000	7.31	8.77	22.9	2.19	3.65	1.460
4000	9.80	11.80	30.7	2.94	4.90	1.960
5000	12.20	14.70	38.4	3.67	6.11	2.440
6000	14.60	17.60	46.0	4.39	7.32	2.930
7000	17.10	20.50	53.7	5.13	8.55	3.420
8000	19.50	23.40	61.3	5.86	9.77	3.910

Table 12

Net Air Pollution Emission Reductions for a Characteristic Low-Rise Apartment Building (24 dwelling units) With Improved Insulation (tons x 10^{-3}/year)

GAS HEAT

Degree Days	Particulates	Nitrogen Oxides	Sulfur Oxides	Hydro Carbon	Carbon Monoxide	Aldehydes
2000	2.0	5.1	.06	0.8	2.1	1.0
3000	2.9	7.5	.09	1.2	3.0	1.5
4000	3.9	10.3	.12	1.7	4.2	2.1
5000	4.9	12.7	.15	2.1	5.1	2.5
6000	5.8	15.0	.18	2.4	6.1	3.0
7000	6.8	17.8	.21	2.9	7.2	3.6
8000	7.7	20.2	.24	3.3	8.1	4.0

OIL HEAT

Degree Days.	Particulates	Nitrogen Oxides	Sulfur Oxides	Hydro Carbon	Carbon Monoxide	Aldehydes
2000	8.2	9.9	25.8	2.5	4.1	1.6
3000	12.3	14.7	38.6	3.7	6.2	2.5
4000	16.4	19,7	51.4	4.9	8.2	3.3
5000	20.5	24.7	64.5	6.2	10.3	4.1
6000	24.6	29.5	77.3	7.4	12.3	4.9
7000	28.7	34.5	90.0	8.6	.4.4	5.8
8000	32.8	39.4	103.3	9.9	16.4	6.6

Water Pollution and Solid Waste

Surprisingly, reductions in water pollution emissions and solid waste generation can also be attributed to more efficient space heating of buildings, wherever electricity is used as an energy source. Power plants burning oil or coal contribute water pollution to the environment from their cooling water, and the ash from the burning of coal is a source of solid waste. Scrubber technologies for power plant air pollution control may result in large quantities of solid waste. Since coal is expected to play a larger role in the future in the nation's energy picture, water pollution and solid waste production figures are presented in Table 13 to give some idea of the potential environmental impacts of reducing power demand in the home.[12]

Interior Air Quality Considerations

A conventional older house, loosely caulked and weatherstripped, experiences a high infiltration of outside air, and consequent loss of heating efficiency. However, this outside air does provide valuable ventilation, amounting to one-half to one-and-one-half air changes per hour on average, throughout a house. Caulking and weatherstripping, while they decrease heat loss, may also decrease ventilation down to undesirable levels. The effect is most pronounced in new construction, where all building components fit tightly, but even retrofitting older construction can seriously decrease ventilation.

Many houses today are being built without full foundations--they have only a concrete slab on grade. Furnaces may then be located adjacent to living spaces. In a well-sealed house, provision of air for fuel combustion may be constrained: although infiltration does occur through door and window seals, it may not match the air demand of the furnace. The result is that the furnace chimney loses efficiency, and a part of the flue gases may be emitted into the house. Provision of an outside air source for the fuel burner should be provided, expecially where furnaces are located in or near living spaces.

In forced hot air systems for commercial buildings, standard design calls for seventy-five percent of the returned air to be reheated and recirculated, with the rest supplied from fresh outside air; outside vents are usually provided for this purpose. This level of ventilation is not commonly required for residential hot air systems, but, except in very old systems, the circulated air and the air in the combustion system are segregated. Housing using forced hot air will receive considerable ventilation despite the sealing of walls, windows and doors, though there is an energy penalty paid for heating the colder outside air.

All systems that do not circulate air, such as circulated hot water, steam, or electric baseboard, yield lower fresh air ventilation. In this case, interior air quality may suffer badly, even if there is no contribution of pollution from the furnace. Other sources of indoor air contaminants include cooking (especially from unvented natural gas combustion), auto-use related air pollution from attached garages, interior dust (elevated by

Table 13

Approximate Water Pollution Emission and Solid Waste Reduction

Due to Improved Insulation of Electrically Heated Single Family Houses

UNITS: tons/year/1000 houses

(Assumes Coal-fired Power Plant)

Degree Days	WATER POLLUTION					SOLID WASTE
	Acids	Dissolved Solids	Suspended Solids	Organics (tons x 10^{-3})	Thermal Pollution (BTUs x 10^{9})	
3000	.43	1.90	.11	.05	8.80	.81
4000	.57	2.50	.15	.06	11.80	1.09
5000	.96	4.10	.26	.10	19.80	1.83
6000	1.16	5.00	.31	.12	23.80	2.20
7000	1.37	5.90	.37	.15	28.20	2.61
8000	1.55	6.70	.41	.16	31.80	2.94

walking and cleaning), tobacco particles and smoking-related contamination, and solvent evaporation from cleaning chemicals.[13]

Thus, while a tightly-sealed house does cut down on energy use, it is not an unmitigated benefit. An optimum balance between weather-sealing and ventilation requirements has not yet been worked out, but at a minimum, adequate supplies of outside air should be provided for fuel combustion in furnaces; in a well-designed system this should have no effect on fuel conservation.

STANDARDS AND INCENTIVES FOR IMPROVED INSULATION

This section of the chapter presents the basic strategies available for a local community to maximize the energy efficiency of its housing stock, both new and old. First, improvements in the standards of new construction are proposed, following the Department of Housing and Urban Development's new additions to the Minimum Property Standards and certain construction practices proposed by private research as applicable to multi-family buildings. Next, a discussion of retrofitting older houses with energy conservation improvements is presented, bringing out the financial barriers to investments in energy conservation, and presenting ways around them currently available on the local level. Other supports and incentives to energy conservation in housing are presented in the next section: these are related both to new and old housing. The use of land use controls for energy conservation in the housing sector is discussed in relation to certain recent studies relating energy consumption to land use patterns. The final section is devoted to an overview of the costs and implementation problems associated with each of these strategies.

New Construction Standards

The most direct and effective way to promote energy conservation is through the use of revised building code standards for new construction Application of thicker insulation, better weatherstripping and caulking, and the installation of storm doors and windows are more easily and cheaply done when a building is designed and built. Upgrading older structures is a more expensive practice. Insulation must be injected into closed wall spaces, attic ceilings or floors removed and replaced, and often it is not worth the trouble and expense involved to upgrade, for instance, four inches of attic insulation to the desired six inches. Application of storm doors and windows can become exceptionally expensive, since older windows and door frames may not conform to present standard sizes. It is both inequitable and impractical to focus the retrofitting of local buildings to conform to the same insulation standards as new construction. Retrofitting should be approached through the use of incentives for voluntary programs, as discussed in the following section.

The Department of Housing and Urban Development has revised its Minimum Property Standards for one and two family dwellings to include better thermal insulation standards.[14] These revisions are presented in "Building Standards" below, they require weatherstripping and insulation, and limit total heat transmission through walls, floors, ceilings, doors, and windows. They can easily be included as part of a local building code, either in whole or in substantial part. Different amounts of insulation are called for according to climate, with the major breaking point at 4,500 degree-days. This corresponds to the climate of cities like Baltimore, Maryland; St. Louis, Missouri; or Eugene, Oregon.

Vacation and other seasonal buildings are potentially exempt from the revised building standards, since additional expense involved in insulating them to winter standards may be irrelevant to their use. Local communities must use their own judgment on requiring more expensive building standards for such homes: often the seasonal home market in a community may involve winter users almost exclusively--towns in the vicinity of ski resorts are the obvious example. If the size of the seasonal community within a town is small, application of improved insulation standards to these homes may not be an issue, but where it is extensive, local governments may find it advisable to require uniform building standards here too. Where seasonal homes are on the outskirts of a major metropolitan area, spreading suburbanization often leads to the eventual conversion of such homes for year round use.[15]

Standards for the improvement of insulation of multi-family structures have not yet been promulgated by HUD. In general, investors in larger scale multi-family housing are more sensitive to the long range operations and maintenance expense of their buildings, though in some markets developers do seek to minimize the length of time they are financially committed to a project and thus do not care about the long range heating and cooling costs involved--their incentive is to minimize first cost. The standards for multi-family dwellings presented in "Building Standards" below are brief, and consist simply of the structural modifications proposed by a HUD research project[16] for application to townhouses, low-rise apartments, and high-rise apartments.

Retrofitting Existing Construction

Financing Retrofit Installations --

Retrofitting existing structures with better insulation, more efficient furnaces, and other conservation improvements will yield significant private savings; indeed, most homeowners can be almost guaranteed of recouping their investments, perhaps with substantial profit, over the long term. While forcing retrofit through the use of some sort of retroactive building code standard is inequitable as well as virtually impossible politically, the benefits of energy conservation are such that adequately informing owners of the long term savings involved can yield widespread improvements in local housing stock.

In the previous section we calculated the approximate fuel savings to be expected in different areas of the country for different fuels, on the basis of a single standard home.[17] We can use these figures again to demonstrate the process of calculating the cost and benefit streams of various methods of financing insulation in homes.

Table 14 shows the savings, in fuel (by appropriate measure) and in dollars accruing to the insulation of the typical single family house according to the standards set forth for new construction. This includes insulation of walls and attics, provision of glass storm windows and doors, and a thorough weatherstripping and caulking of doors and windows. The cost of doing this is estimated at $1500 1976 dollars.[18] Conversion of fuel savings to dollars was done using the national average cost for each fuel at $1.52 per thousand cubic feet of gas, $.35 per gallon of distillate fuel oil, and $.035 per kilowatt hour of electricity.[19] These national average figures are useful in most instances except in the case of natural gas, in which there is wide variation nationwide in the price per unit. While oil prices appear to vary (in 1975) from a low of about $.30 per gallon in South Carolina to about $.40 per gallon in West Virginia, with the average price being between $.34 and $.37,[20] gas prices fluctuate widely from a low of about $.53 per thousand cubic feet in Kansas to a high of about $3.80 in Maine. Cost recovery periods were calculated by assuming that these fuel prices remain constant, and that the costs of the capital improvements necessary can be treated as a loan at ten percent against which the savings are payments. It is clear that under the present relatively cheap price of natural gas, retrofit of housing is not cost-effective. Where gas prices are higher, however, effectively matching or exceeding the per BTU cost of oil, figures in the next column over are more appropriate. And for electricity, it appears on the chart that in areas of from 4000 degree-days and colder, payback periods on insulation investments are ten years or less. This does not take into account the rising price of fuel and the tax deduction available on interest paid on home improvement or other financing to install the insulation.

Table 14 does not go far enough in presenting all the relevant facts a homeowner must interpret to decide whether insulation is a wide investment for him. The most accurate way to estimate the value of fuel savings is to assess their discounted present value, taking expected rises in fuel costs, the condition of the local housing market, the availability of home improvement financing and other factors into account.

Retrofitting older homes can be financed in several ways. The buyer of a used home can usually persuade a local bank to include the price of upgrading the energy efficiency of his home in the sum of the mortgage. The incremental monthly payment attributable to the added insulation is small, and spread over the life of the mortgage; the homeowner will see significant net cash savings immediately, for his fuel savings should be greater than the additional payment if he has made a careful evaluation of his requirements. But if a current owner of a home seeks to retrofit, he usually must finance the costs with short term financing--either through a home improvement loan (currently at about ten percent interest over one to four years) or through consumer financing such as Master Charge (at up to eighteen percent per year interest). In this case the large monthly payments over the short term of the loan usually are much larger than the average monthly fuel savings. The owner has to wait perhaps several years beyond the loan term to come out ahead over all, and by then he may have sold the house.

Most homeowners now stay in their present homes a little less than ten years,[21] so the average homeowner is likely to expect to live in the same

Table 14

Approximate Fuel Savings Accruing to Improved Insulation of a Characteristic Single-Family House

DEGREE DAYS	GAS SAVINGS			OIL SAVINGS			ELECTRICAL SAVINGS		
	1000 ft.^{2}	$	Payback Period (years)	gallons	$	Payback Period (years)	KwH	$	Payback Period (years)
3000	28	43	∞	243	85	∞	6556	229	11.2
4000	36	55	∞	323	113	∞	8757	306	7.1
5000	62	94	∞	548	192	15.9	14771	517	3.6
6000	74	112	∞	659	231	11.0	17752	621	2.9
7000	87	132	∞	769	269	8.6	21001	735	2.4
8000	99	150	∞	878	307	7.0	23647	828	2.1

place another five years or so. Trying to convince a typical homeowner to install expensive storm windows and doors, wall insulation, and attic insulation may be difficult, since he may not plan to stay where he is long enough to realize net savings on the investment. His only hope to get his money out of the investment may be to tack on the price of it to the sales price of the building. His decision to invest will then depend on his own assessment of the chance of success in doing so.

Table 15 presents sample present value calculations[22] for insulation improvements to the characteristic house discussed above. Different financing strategies are compared against the savings expected in different climates around the country. A number of assumptions must be made clear. First, the fuel savings used were those for oil heat:[23] natural gas prices exhibit too much variation nationwide for the average figure to be generally meaningful, and it can be expected that the price of gas will tend to rise in the future to something comparable to the price of equivalent amounts of oil. It was also assumed that the price of fuel oil would double, in constant dollars, by the year 2000,[24] and that inflation would add another three percent per year to the market price.[25] Mortgage rates were estimated at nine percent for a twenty-five year mortgage at eighty percent of the home's value. The discount rate a homeowner might apply to the stream of benefits and costs was placed at five percent, on the assumption that the most likely alternative investment available to a middle income homeowner would be a savings account. Finally, an income tax bracket of twenty-eight percent was selected for calculating the tax benefits available on interest charges. This is typical for families filing a joint return and making $16,000 to $20,000 annually.[26]

Finally, two different estimates of construction costs were used. In the previous section it was assumed that the total cost of adding extra insulation to the new home would be $1500. For the retrofit installation, a figure of $1750 was used, since fitting storm windows and doors to an older building is usually more costly than fitting them to new construction, and the cost of insulating finished walls and ceilings will be greater than for original construction.

While the theoretical value usually ascribed to investments in energy saving technology is the full discounted value of the fuel savings over time, less the costs of the investment, at present the housing market does not recognize this to be true. This is because homes change hands before the long term benefits can accure to a single owner. Any prospective buyer, given the choice between two identical properties--one insulated and one not--would be foolish to pay the full value of the future fuel savings to the seller of the insulated house. Instead, he would buy the uninsulated property and get all the savings for himself for the cost of insulating, still retrainig all the cash flow advantages of long term financing on the mortgage. Only when most properties in a community market become insulated does it become possible to capitalize fuel savings into the value of housing stock.

Most homeowners are conservative, and often prefer not to take much of a risk in having to add the price of insulation to the selling price of their home. Invisible improvements such as insulation are generally worth less

Table 15

The Net Value of Insulation Improvements in Various Climates

		[+]PRESENT VALUE OF COSTS*	PRESENT VALUE OF BENEFITS**	NET PRESENT VALUE
BALTIMORE 4600 degree days	loan @ 10% on $1750	1884.16	2748.41	864.25
	mortgage @ 9.5% on $1200 plus deposit = $300	1995.57	2963.14	967.57
	mortgage @ 9.5% on $1400 plus deposit = $350	2327.41	3011.12	683.71
BOSTON 6000 degree days	loan @ 10% on $1750	1884.16	4804.62	2920.46
	mortgage @ 9.5% on $1200 plus deposit = $300	1995.57	5019.35	3023.78
	mortgage @ 9.5% on $1400 plus deposit = $350	2327.41	5067.33	2739.92
MINNEAPOLIS 8000 degree days	loan @ 10% on $1750	1884.16	6376.96	4492.80
	mortgage @ 10% on $1750	1884.16	6376.96	4492.80
	mortgage @ 10% on $1350 plus deposit = $350	2327.41	6639.67	4312.26

[+] All calculations assume a home owner discounts all future payments and benefits at 5%, the interest rate he might otherwise realize on his most likely alternate investments--e.g., a savings account.

*Includes present value of loan payments, plus mortgage down payments where applicable.

**Includes fuel savings and income tax deductions on loan interest paid.

in the marketplace than a fresh paint job or an extra bathroom when it comes time to sell. Homeowners may be acting logically when they decide that an expensive retrofit job, which seems on paper to be worth the money, it not the best home improvement investment they could make. Communities can take a number of approaches in encouraging energy conservation investments, as discussed below.

Community Incentives for Retrofit --

A number of strategies are available through which local governments may encourage the insulation of homes to reduce energy consumption. The most direct is the use of modified building codes, presented above. If, however, such code modifications are not made, the strategies below will still be applicable. Some communities may elect not to revise building codes for fear of rises in construction costs that would make them less competitive for growth in the region. The approach outlined under "Property Tax Adjustments" may make revised building codes more attractive to them.

Public Education Programs--Public education programs can be inexpensively set up on the local level to help homeowners make rational decisions regarding the insulation of new or existing housing, and explain town policy to new homeowners building structures that might be covered by revised insulation standards. By the use of the figures presented in this report and similar ones, localities may present homeowners with benefit estimations representative of savings they might realize in their particular region of the country, given the type of fuel they use for heat. Misunderstanding of the true costs and benefits of these home improvements accounts for the economically irrational choices that homeowners have often made in the past. Many electric companies and state agencies will provide free speakers on energy conservation.

Two groups of homeowners must be distinguished: those who own single family houses, and those who own multi-family buildings rented for profit.

Education programs aimed at the first group should concentrate on rationalizing the cost of when to insulate: although all decisions to insulate in areas with 4000 degree-days or more are economically sound in theory, there are instances where the decision not to insulate may be justifiable. In particular, homeowners who plan to sell their property within a period of time substantially less than the payback time of an investment financed under a short term loan may rightly feel that the negative cash flow they will have to support during the remainder of their occupancy will not be justified. Since it is unlikely that they can increase the price of the house more than their costs, they cannot realize the theoretical present value of the investment, and in fact may take a loss if they do not succeed in raising the price. Retrofitting becomes a more reasonable investment for the current owner the colder the climate he lives in, for where fuel savings are highest the payback period is shortest.

Table 16 shows the revised net present value of insulation in the case where a homeowner plans to sell four years from the time of installing conservation improvements. If the full price of the improvement is realized on the sale, then it is rational to make the investment in any case, although the net value of the investment to a homeowner in a warmer climate (e.g.,

Table 16

Present Value of Improved Insulation to A Home Owner Who Plans to Sell in Four Years

	Present Value of Costs*	Present Value of Benefits*									Net Present Pre-Value		
		1) Resale Increase $2000			2) Resale Increase $1000			3) Resale Increase $0					
	loan on $1750, 4 years, 10%	Tax	Fuel	Incr.	Tax	Fuel	Incr.	Tax	Fuel	Incr.	1	2	3
BALTIMORE	(1884.16)	73.33	502.59	1645.40	73.33	502.59	822.70	73.33	502.59	0	336.06	(485.54)	(1308.24)
BOSTON	(1884.16)	73.33	888.90	1645.40	73.33	888.90	822.70	73.33	888.90	0	723.47	(99.23)	(921.93)
MINNEAPOLIS	(1884.16)	73.33	1184.30	1645.40	73.33	1184.30	822.70	73.33	1184.30	0	1018.87	196.17	(626.53)

*All present values assume five percent discount rate.

Baltimore) is very small indeed. If, however, the homeowner fears that the market will not allow him to raise the price fully to cover the cost of the insulation, he may well face a net loss, though in colder climates this may not always be true, as is shown in the table.

Naturally, the situation is different in the case of a new owner of an older house. His expected stay in the building is likely to be in excess of the payback period, so it makes sense for him to make the improvements even if he were unable to recoup the capital costs on resale. Furthermore, he can probably finance the improvement on his mortgage, and though his net present benefit is lower, he realizes month to month cash savings right away.

From the community's standpoint, it should be to everyone's benefit, including the towns, to encourage uniform retrofitting. If most of the town's housing stock becomes insulated, owners will be better able to capitalize the true benefits of fuel savings into the selling prices of houses, since prospective buyers will no longer have the option of buying uninsulated homes and paying only the costs of improvements. Tax assessments could thus rise, and so would property tax receipts.

The situation for owners of multi-family homes is different: tenants often pay utility bills, so owners have no direct incentive to insulate. Were they to do so, they would have to charge more rent to pay off the cost, making them less competitive with other rentable properties. While tenants would have lower fuel costs, many prospective tenants fail to research operating costs when they make a decision to rent. This discourages retrofitting in a competitive market. However, developers of new properties may well take advantage--on their own--of energy saving innovations in construction in order to be able to offer lower rentals. By using long term financing of these relatively inexpensive additions, they would experience no net negative cash flow over the short term, and could minimize operating costs from the start. The resale value of the property would also be increased by perhaps a more predictable amount, as operating and maintenance costs of rental properties are usually carefully evaluated on resale.

Public education programs have already occurred in various cities across the country.[27] The Michigan Consolidated Power Company advertises a booklet they prepared illustrating that six inches of attic insulation could result in a seventeen percent reduction of heating bills, and that the cost could be amortized over 2.3 years. This booklet encouraged a sixty percent rise in sales in insulation locally during the first two years of the program. Philadelphia Electric, combining the efforts of local power suppliers and Montgomery Ward department stores put out their own booklet on energy conservation for homes, which included operational adjustments (thermostat settings, for example) and structure changes (increased insulation, better weatherstripping, etc.). They have since recorded increased sales in energy-related equipment such as storm doors and windows, weatherstripping and insulation.

Although local governments themselves may embark on public education programs to convince consumers to improve the energy efficiency of their properties, local power companies are a resource that should be exploited. They have established communication with home energy users over the years, are

Table 17

Savings

Degree Days	GAS		OIL		ELECTRICITY	
	Savings/Year 100f^3 ($)	Cost Recovery Period (Yrs.)	Savings/Year gals. ($)	Cost Recovery Period (Yrs.)	Savings/Year KwHr ($)	Cost Recovery Period (Yrs.)
3000	28 (42.56)		243 (85.05)	47.2	6556 (229.46)	8.2
4000	36 (54.72)		323 (113.40)	22.8	8757 (306.50)	5.8
5000	62 (94.24)	34.0	548 (191.80)	10.3	14771 (516.99)	3.2
6000	74 (I12.48)	23.1	659 (230.65)	8.1	17752 (621.32)	2.7
7000	87 (132.24)	17.5	769 (269.15)	6.8	21001 (725.59)	2.2
8000	99 (150.48)	14.4	878 (307.30)	5.8	23647 (827.65)	2.0
9000	112 (170.24)	12.1	988 (345.80)	5.0	26628 (913.98)	1.8
10000	124 (188.48)	10.5	1096 (383.60)	4.5	29543 (1034.01)	1.6

familiar with local energy consumption patterns, and have competent professional staffs that can analyze the economics of local energy efficiency improvements.

Problems: The problems that arise in consumer education programs are twofold. First, it is necessary for the program to continue over a long period, so that as much of the local housing stock as possible will be improved. Second, successful education programs, like all incentives, may result in local shortages of required building materials over the short term. This may dampen enthusiasm for the program, especially if prices on materials rise to reflect the shortage.

Energy Efficiency Labeling--Another way to promote energy conservation innovations is through energy efficiency labeling of homes and apartments. The probable energy consumption levels of new housing can be calculated on the basis of construction techniques--such calculations are already made on a rough basis for the sizing of furnaces and air conditioning equipment. Using the analysis techniques developed by various current studies,[28] quite accurate estimates of home heat loss could be made by developers, and since most residential subdivisions are constructed with a small number of differen housing types in large multiples, the costs of complying with the labeling requirement would not be excessive.

Energy labeling of existing housing is easier to do. It would merely require that heating bills for the past year be made available to new owners or tenants of any building. One mechanism by which this could be done is the Occupancy Permit, recently used in some communities to control blight. Under the occupancy permit ordinance, new renters or owners are required to file at city hall for an occupancy permit, which is granted contingent to an inspection of the property that concludes that it conforms to city housing standards and is suitable for the prospective number of applicants.[29] Similarly, energy efficiency performance could be documented under an occupancy permit system without the requirement for actual inspections--the permit could be granted upon proof that the new owner or tenant had been shown valid heating bills for the past heating season.

Tax Incentives--At least one tax incentive is already available for insulation improvements--interest on any loan taken out for the purpose may be deducted from federal income tax. This factor has already been taken into account in calculating the net present value of investments in insulation improvements.

Other tax incentives recently proposed include a twenty-five percent income tax rebate on energy conservation equipment,[30] and energy tax surcharges on home heating fuels to encourage conservation. Neither of these policies can be implemented on the local level. But, there are two routes available to local governments--sales tax incentives (for those large municipalities that have city sales taxes) and property tax assessments.

Exempting energy conservation equipment (insulation, weatherstripping, storm windows and doors, furnace efficiency modifications, etc.) from a local sales tax would mean a break to local contractors or homeowners on the cost of improvements. The loss of sales tax revenues would be minor compared to the net advantage it would represent to local contractors, banks and retail establishments. Sales tax modifications usually ought to be made on the state level, however, to represent widespread significant savings. Their value on a local level might be largely psychological, helping to emphasize a city's committment to energy conservation, which may supplement use of building code revisions, property tax breaks, energy efficiency labeling, public education policies and the like.

Property tax assessment represents perhaps a more fruitful implementation approach for local governments. Tax reassessments are not necessarily made following home improvements such as retrofitting, where no net changes to the size of a building are made. But, on new structures, where the assessment of a building is contingent on its selling price, insulation requirements would end up raising the property tax assessment by a small but significant amount. In addition, this increase would tend to be regressive, representing proportionally more of a burden to owners of less expensive homes. This is because insulation costs are closely proportional to the outside surface area of a building, which rises more slowly than its interior square footage in larger houses; selling prices of housing are a function of many other factors besides absolute building size, with more expensive new homes seldom being larger in size proportional with their increased sales price. An assessment policy that discounted all insulation and energy conservation equipment in new housing before figuring the tax assessment would be a significant spur to building improvements, and might be the equitable course to follow if building codes are modified to specify higher standards. While the total present value of such a tax readjustment would be small in comparison with long term energy savings, it might have a positive effect on short term cash flow for homeowners.

AIR POLLUTION EFFECTS OF ZONING AND LAND USE CHANGES

Reduction of pollution emissions from stationary sources can be effected indirectly through the use of zoning changes, but from the outset, readers should remember that there are no necessary relationships between land use and energy consumption: all correlations observed are contingent on assumed or observed technologies for heating, transportation, and other energy land uses. At present, many traditional assumptions about future energy technologies are threatened, and a variety of new energy technologies, such as solar, geothermal, nuclear fission, nuclear fusion, wind and high-energy kinetic, are at the threshold of major development. It is a virtual certainty that some (or possibly all) of these will play major roles in the nation's energy economy; each would also tend to promote land use patterns compatible with itself. Until these technologies achieve greater definition, analysis of the optimal configuration of land development for energy conservation remains partially speculative.

Increases in Built Density

The range of densities to which land is developed is very broad, but where conservation of energy for space heating is concerned the most interesting interval is that which involves changes in building format from individual structures (detached houses and commercial structures) to progressively aggregated ones. Changes of land use density of detached building results in negligible or zero savings on space heating needs; a moderate savings is gained where detached buildings are clustered together to reduce incident wind velocity, but the same effect can usually be gained through landscaping and siting measures.

As was seen in the first part of this chapter, multi-family (i.e., attached) dwelling units use less energy per dwelling unit for heating purposes. A study by Arthur D. Little, Inc.,[31] which analyzed typical units in four regional climates, suggested that on average, a high-rise apartment in the severe winters of the North Central region uses sixty-two percent less heat per dwelling unit than a single-family house (though only about thirty-four percent less per square foot); a low-rise apartment used fifty-eight percent less (twenty-seven percent less per square foot). Townhouse-type attached single-family units use twenty-four percent less fuel (overall, but are about comparable to detached units on a per square foot basis). Mobile homes in the same climate, although smaller than either apartment type (720 square feet versus 900 square feet) used more total energy for heat overall; on a square-foot basis, furthermore, mobile homes used ten percent more energy than a conventional single-family house.

On the basis of such evidence it is apparent that going to higher density housing saves energy. Adjusting these figures for average occupancy rates,[32] low-rise apartments use about fifty-six percent less fuel per occupant than detached single-family units, and high-rises about fifty-three percent less Townhouses save twenty percent per person. It is interesting that walk-up apartments appear to be the most efficient of all on a per capita basis.

Obviously, community planning cannot proceed on the basis of these average occupancy figures. Not many people prefer high-rise living to single-family houses--studies show that perhaps less than ten percent of the population does.[33] However, many suburban communities tend to ignore the small demonstratable market for more energy-efficient housing formats in favor of almost exclusive emphasis on single-family detached units.

It is not necessary to repeat the process of translating fuel consumption into total air pollution emissions. The Costs of Sprawl calculated emission rates from space heating of buildings for six different community layouts, ranging in developed density from 4.6 to 2.18 units per developed acre. Air pollution emissions from space heating were found to be forty-three percent less for a high-density planned community than for a conventional low-density sprawled-out community, and twenty-six percent for a community with a planned mix of dwelling unit types. A penalty may be paid in ambient air quality when density is increased, however. In the immediate developed neighborhood of a higher density community, savings in fuel burned per dwelling unit may be more than offset by the increased development density.

Heating-related emissions per developed acre in the high-density community were found to be twenty-one percent higher than for the conventional sprawl community, ten percent higher in the planned community. Although the number of auto trips generated in the higher density communities were calculated to decline in length and frequency on a per capita basis, auto-related pollutants emitted per developed acre found to rise in the higher density options. Considering the additional open space made available in the higher density planned communities in which air pollutants can be dispersed, it is not clear whether actual ambient air quality in the developed areas will rise or fall.

APPENDIX III-1: BUILDING STANDARDS AND TECHNICAL DATA

Building Standards

This section includes two sets of modifications ot present building practices appropriate for improving insulation standards in new construction, one for single family housing and one for multiple family housing. It also presents relevant portions of the recommended energy conservation standards for buildings recently promulgated by the American Society of Heating, Air Conditioning and Refrigeration Engineers (ASHRAE). The single family housing standards are derived from the Department of Housing and Urban Development, Minimum Property Standards, as revised in 1974. These standards require weatherstripping, and insulation, and limit total heat transmission through walls, floors, ceilings, doors, and windows. They could easily be included as part of a building code.

The standards for multi-family dwellings are simply the structural modifications proposed by Hittman Associates, which include reducing window surface, improving glass use, and increasing insulation.

Both sets of modifications use technical measures of heat transmission through walls. These measures, R and U, are used for simple heat transfer calculations, and are derived as follows:

(1) Thermal conductivity, k=heat (Btu) per hour transferred through a 1-in. thick, 1-sq.ft. area of homogeneous material per ^{O}F of temperature difference from surface to surface. (The unit for k is (Btu)(in.)/(hr)(sq.ft)(^{O}F).) To qualify as thermal insulation, a material must have a k value of 0.5 or less.

(2) Conductance, C=k/thickness, is the corresponding unit for a material of given thickness. (The unit for C is (Btu)/(hr)(sq ft)(^{O}F).) For a 2-in.-thick plank of insulation whose k=0.20, C=0.10.

(3) Thermal resistance, R=1/C, measures a material's resistance to heat flow. (A material with C=0.25, denoting heat transmission of 0.25 Btu per hr through 1-sq ft of material per ^{O}F, has an R value of 4.0. Under steady-state conditions, it would take 4 hours to transmit 1-Btu through 1-sq ft for a 1^{O}F temperature differential, inside to outside.)

(4) Overall coefficient of thermal transmission, U, is a unit like k and C, measured in Btu transmitted per hour through 1-sq ft of construction per °F from air on one side to air on the other. It relates, however, to the several component materials in a wall or roof. U can be calculated from the following formula:

$$U = \frac{1}{\Sigma R}$$

where ΣR=sum of the thermal resistance of the components, plus the resistance of the inside and outside air films.

Insulation is generally labeled with its R value, to aid in calculating its effect (and must be so labeled for the HUD standards). U is derived from the R values of the materials used, including not only the insulation, but also dead air spaces, structural members, and other components. U is a better measure to include in standards than R, because it includes all factors related to heat loss through walls.

Single-Family Residential Standards [34]

507-3 BUILDING INSULATION

507-3.1 Materials used for insulation shall be of proven effectiveness and adequate durability to assure that required design conditions concerning heat losses, sound control or fire rating are attained. Insulation in contact with the ground shall not be adversely affected by soil, vermin or water.

507-3.2 Labeling

Labeling of insulation shall be as follows:

a. Batt or Blanket. Insulation type, manufacturer or distributor, R value of the fiber at the labeled thickness.

b. Reflective. Insulation type, manufacturer, R value for direction of heat flow, type of facing.

c. Blowing or Pouring Type for Use in Open Horizontal Areas (Attics). Name, manufacturer, recommended installation density, R value, marking on bag of conformance with F.S. HH-I-1030 or HH-I-515.

d. Labeling and marking of all other insulation materials shall comply with the appropriate standard listed below.

607-3 BUILDING INSULATION

607-3.1 General

a. Insulation of buildings shall be such as to assure conservation of energy, economy of operation and confort to the occupants. A building which is both heated and cooled shall be insulated against the more severe climatic conditions for the location.

b. INSULATION MAY BE OMITTED FROM SEASONAL HOMES, NOT INTENDED FOR YEAR-ROUND OCCUPANCY, AT THE DISCRETION OF THE OFFICE WHOSE DETERMINATION SHALL BE BASED UPON CLIMATIC CONDITIONS AND THE PROPOSED SEASON OF OCCUPANCY OF THE PROPERTY.

607-3.2 Overall Coefficient of Heat Transmission

a. All buildings which are heated or cooled mechanically shall be constructed to comply with the maximum U values shown in Tables 6-7.1, 6-7.2 and 6-7.3. U values shown do not include adjustments for framing in walls, ceilings or floors, nor for the sash frame in windows or glass doors.

b. Where the stated U value of any one component of roof deck, ceiling, wall or floor cannot be practically obtained, such U value may be increased to the minimum figure attainable and the U value for other components decreased until the overall heat gain or heat loss does not exceed the total resulting from conformance to the stated U values.

607-3.3 Roof Decks, Ceilings, Walls and Openings

a. For roof decks, ceilings, walls and door and window openings, U values shall not exceed those shown in Table 6-7.1. In areas of 4500 or less winter degree days and 400 or more summer cooling hours, buildings to be mechanically cooled shall be insulated as for areas of 4501 to 8000 winter degree days, except for glazing.

TABLE 6-7.1

Maximum "U" Values of Ceilings, Walls and Openings

Winter Degree Days(2)	Flat Roof(1) Deck	Masonry Wall Construction		Frame Wall Construction		Doors and Windows
		Ceilings	Walls	Ceilings	Walls	
4500 or less	.14	.05	.10	.08	.08	1.13
4501 to 8000	.09	.05	.10	.05	.08	.65
8001 or more	.09	.04	.10	.04	.08	.65

Notes:

(1) Indicates construction with rigid roof insulation and exposed structural system. When roof cavity is available use column for ceilings.

(2) Winter degree days are based upon the difference between 65 F and the mean daily outdoor temperature.

b. When blown or poured type of insulation is installed in attics, caution shall be exercised to assure complete and adequate application of insulation. When eave vents are installed, adequate baffling of the vent opening must be provided so as to deflect the incoming air above the surface of the installed blown or poured insulation. Baffles shall be installed prior to insulation, shall be of wood or other durable material and shall be installed at the soffit on a 60 degree angle from the horizontal.

607-3.4 Floor Sections

a. For floors over unheated basements, unheated garages or ventilated crawl spaces with operable louvers, the "U" value of the floor section shall not exceed the value shown in Table 6-7.2.

TABLE 6-7.2

Maximum "U" Value of Floor Sections Over Unheated Basements, Unheated Garages or Crawl Spaces (1)

Winter Degree Days	Structural Slab	Wood and Metal Framing
2500 or less	No requirement	No requirement
2501 to 4500	0.15	0.10
4501 or more	0.12	0.08

(1) A basement, crawl space or garage shall be considered unheated unless it is provided with a positive heat supply to maintain a minimum temperature of 50 F.

607-3.5 Basement or Crawl Space Foundation Walls

Insulation may be omitted from floors over heated basement areas or heated crawl spaces if foundation walls are insulated. Foundation walls of heated basements need not be insulated except where habitable rooms are provided or where 50 percent of the wall is exposed to outside air. The "U" value of foundation wall sections shall not exceed the value shown in Table 6-7.3.

TABLE 6-7.3

Maximum "U" Values of the Foundation Wall Sections of Heated Basement or Heated Crawl Space.

Winter Degree Days	Maximum "U" Value
2500 or less	No Requirement
2501 to 4500	0.24
4501 or More	0.17

607-3.6 Crawl Space Plenum Walls

When a crawl space is used as a supply or return plenum, the crawl space perimeter wall shall be insulated to provide a maximum heat loss of 35 Btuh per lineal foot of perimeter wall assuming a crawl space air temperature of 70·F for return plenums and 110 F for supply plenums.

607-3.7 Slab-on-Ground Floors

Edge heat loss of concrete slabs around the perimeter of heated spaces shall not exceed a maximum value per linear foot of exposed edge of 42 Btuh for unheated slabs and 50 Btub for heated slabs. Calculations of heat loss through concrete slabs shall be made using the formula H = F x P.

Where:
H = Heat loss of the slab edge (Btuh)
F = Heat loss coefficient from Table 6-7.4 (Btuh per linear foot of exposed edge).
P = Perimeter or exposed slab edge (linear feet).

TABLE 6-7.4

SLAB EDGE HEAT LOSS COEFFICIENTS (Btuh per Linear Foot)

Winter Design -Temperature	Total Width of Insulation(in.)	F for unheated slab			F for heated slab(2)		
		R=5.00	R=3.75	R=2.50	R=5.00	R=3.75	R=2.50
-30 F or colder	24	34			46		
-25 F to -29 F	24	32			44		
-20 F to -24 F	24	30			41		
-15 F to -19 F	24	28			39		
-10 F to -14 F	24	27	40		37		
- 5 F to - 9 F	24	25	38		35		
Zero to - 4 F	24	24	36		32	48	
+ 5F to + 1 F	24	22	33		30	45	
+10F to + 6 F(1)	18	21	31	42	25	38	50
+15F to + 11 F	12	21	31	42	25	38	50

*Notes: (1) Where Winter Design Temperatures are warmer than +15F, perimeter insulation is not required. If installed in these areas (edge only) use values shown for +15 F to + 11F above.

(2) Slab floor with heating pipes or ducts in or immediately under slab.

(3) Insulation R-Values shown are for thermal insulation resistance (R = 1/C).

Weatherstripping

All exterior doors shall be provided with a tight threshold and weatherstripping to reduce infiltration of undesirable outdoor elements.

Weatherstrip windows to reduce infiltration of undesirable outdoor elements.

Materials Standards for Building Insulation

Cork Board	FS HH-I-525
Cellular Glass	FS HH-I-551
*Cellulose, Vegetable or Wood Fiber	FS HH-I-515
Expanded Polystyrene Insulation Board	FS HH-I-524
Fiberboard	FS LLL-I-535 Class C or E or ASTM C-208
Insulation Board (Urethane)	FS HH-I-530
*Mineral Fiber, Board (Roof)	FS HH-I-526
Mineral Fiber, Insulation Blanket	FS HH-I-521
Mineral Fiber, Pneumatic or Poured	FS HH-I-1030
Perimeter Insulation	FS-HH-I-524 Type II FS HH-I-558, Form A, Class 1 or 2
Reflective, Thermal	FS HH-I-1252
Structural Fiberboard Insulating roof deck	AIMA IB Spec. No. 1
*Vermiculite	ASTM C-516
*Perlite	FS-HH-I-574

THERMAL AND MOISTURE PROTECTION

Recommended Reference Guide - NAHB Insulation Manual for Homes and Apartments.

Multi-Family Housing Standard[35]

The townshouse was defined with 1300 square feet of floor area.

The low rise was defined with 1140 square feet of floor area, and the Highrise was defined with 850 square feet of floor area per apartment.

Improvements included

a. reduction of window area to

Townhouse	95 square feet
Low rise	90 square feet
High rise	60 square feet

b. Storm windows on the townhouse and double glazing on the low rise and high rise.

c. Increase the insulation value ("R" value) of the ground floor, walls, and roof to

	Ground Floor	Walls	Roof
Townhouse	20	10.6	21.7
Low rise	20	10.6	21.7
High rise	20	10.6	9.7

ASHRAE 90-75 Standards

The following standards are taken from the recent publication by ASHRAE of standards for the design of building sheels and heating and ventilation equipment (HVAC). Unlike the HUD standards, these are not directly suitable for inclusion in local building codes; rather, they are guides for engineers and architects to use in designing structures and mechanical plants. They are included here because they represent the way in which the Federal Energy Administration is currently designing their approach to long term energy conservation in buildings--that is, through the use of performance standards rather than prescriptive building standards. For local governments today, they have most relevance for the design and construction of commercial and larger residential structures not for small-scale detached housing. They are reproduced with permission of ASHRAE.

4.0 EXTERIOR ENVELOPE REQUIREMENTS

4.1 Scope

The criteria of this section establish the minimum requirements for thermal design of the exterior envelope of new buildings. The equations, charts and tables in this section are intended only for use in defining these criteria. In cases where a system analysis approach to building design is desired, the requirements of Section 10 and/or 11 of this Standard shall apply.

4.2 General

4.2.1 The intent of this section is to provide minimum requirements for building envelope construction in the interest of energy conservation. *These requirements are not intended nor should they be construed as the optimization of energy-conserving practices.*

Paragraph 4.3 applies to one- and two-family residential dwellings and to low-rise, multi-family residential buildings, including hotels and motels, not exceeding 3 stories above grade. Paragraph 4.4 applies to all other buildings not covered by 4.3. Paragraph 4.5 applies to all buildings.

4.2.1.1 In addition to the criteria set forth in this section, the proposed design should consider energy conservation in determining the orientation of the building on its site, the geometric shape of the building, the building aspect ratio (ratio of length to width), the number of stories for a given floor area requirement, the thermal mass of the building, the exterior surface color, shading or reflections from adjacent structures, surrounding surfaces or vegetation, opportunities for natural ventilation, and wind direction and speed. Calculation procedures and information contained in Chapters 17-22 of the 1972 ASHRAE HANDBOOK OF FUNDAMENTALS[4-6] may be used as guidelines to evaluate the above factors.

4.2.2 The *gross area of exterior walls* consists of all opaque wall areas (including foundation walls, between-floor spandrels, peripheral edges of floors, etc.), window areas (including sash), and door areas, where such surfaces are exposed to outdoor air and enclose a heated and/or mechanically cooled space (including interstitial areas between two such spaces).

4.2.3 A *roof assembly* shall be considered as all components of the roof/ceiling envelope through which heat flows, thereby creating a building transmission heat loss or gain, where such assembly is exposed to outdoor air and encloses a heated and/or mechanically cooled space.

4.2.3.1 The gross area of a roof assembly consists of the total interior surface of such assembly, including skylights exposed to the heated and/or mechanically cooled space.

4.2.3.2 Where return air ceiling plenums are employed, the roof/ceiling assembly shall:

a. for thermal transmittance purposes, *not include* the ceiling proper nor the plenum space as part of the assembly, and
b. for gross area purposes, be based upon the interior face of the upper plenum surface.

4.2.4 All buildings that are heated and/or mechanically cooled shall be constructed so as to provide the required thermal performance of the various components.

4.2.4.1 The stated U_o value of any one assembly, such as roof/ceiling, wall or floor, may be increased and the U_o value for other components decreased provided that the overall heat gain and/or loss for the entire building envelope does not exceed the total resulting from conformance to the stated U_o values.

4.2.5 For calculations called for under this section, the following temperatures shall apply:

	Indoor		Outdoor
	F	°C	
Winter	72	22.0	97½%*
Summer	78	25.5	2½%*

*Values from 1972 ASHRAE HANDBOOK OF FUNDAMENTALS[7], Chapter 33.

4.2.6 A building that is designed to be both heated in winter and cooled in summer shall meet the more stringent of the heating or cooling requirements of the exterior envelope as provided in this section when requirements differ.

4.2.7 The design of buildings for energy conservation shall not create conditions of accelerated deterioration from moisture condensation.

4.3 Criteria for Type "A" Buildings

4.3.1 Type "A" Buildings shall include:

A-1 Detached one- and two-family dwellings

A-2 All other residential buildings, 3 stories or less, including but not limited to: multi-family dwellings and hotels and motels.

4.3.2 Heating and Cooling Criteria

4.3.2.1 Walls. Any building that is heated and/or mechanically cooled shall have a combined thermal transmittance value (U_o value) for the gross area of exterior walls not exceeding the values shown in Fig. 1, using Heating Degree Days as given in the 1973 ASHRAE HANDBOOK & Product Directory, Systems Volume, Chapter 43[8].

4.3.2.1.1 Eq. 1 shall be used to determine acceptable combinations to meet the requirements of Fig. 1.

Fig. 1

U_o WALLS—TYPE "A" BUILDINGS

TYPE A BUILDINGS SHALL INCLUDE:
A 1 DETACHED ONE AND TWO FAMILY DWELLINGS
A 2 ALL OTHER RESIDENTIAL BUILDINGS, THREE STORIES OR LESS, INCLUDING BUT NOT LIMITED TO:
MULTI-FAMILY DWELLINGS
HOTELS AND MOTELS

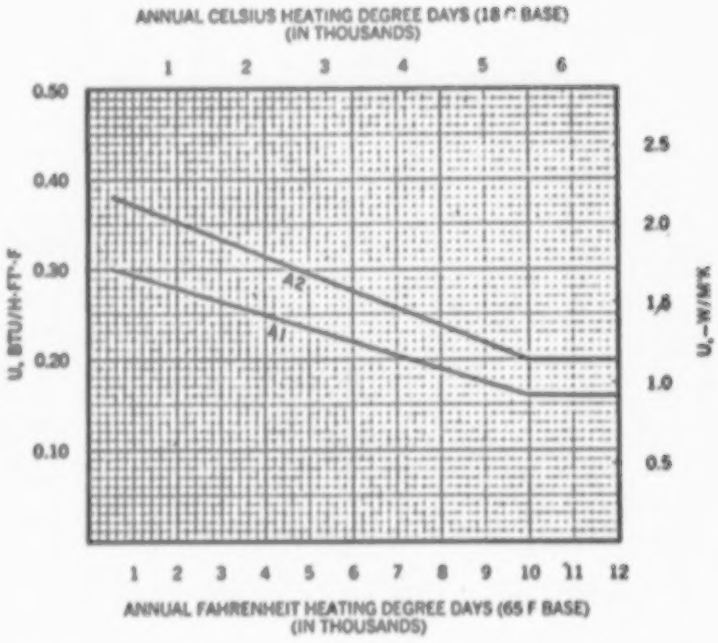


Fig. 2

R VALUES—SLAB ON GRADE

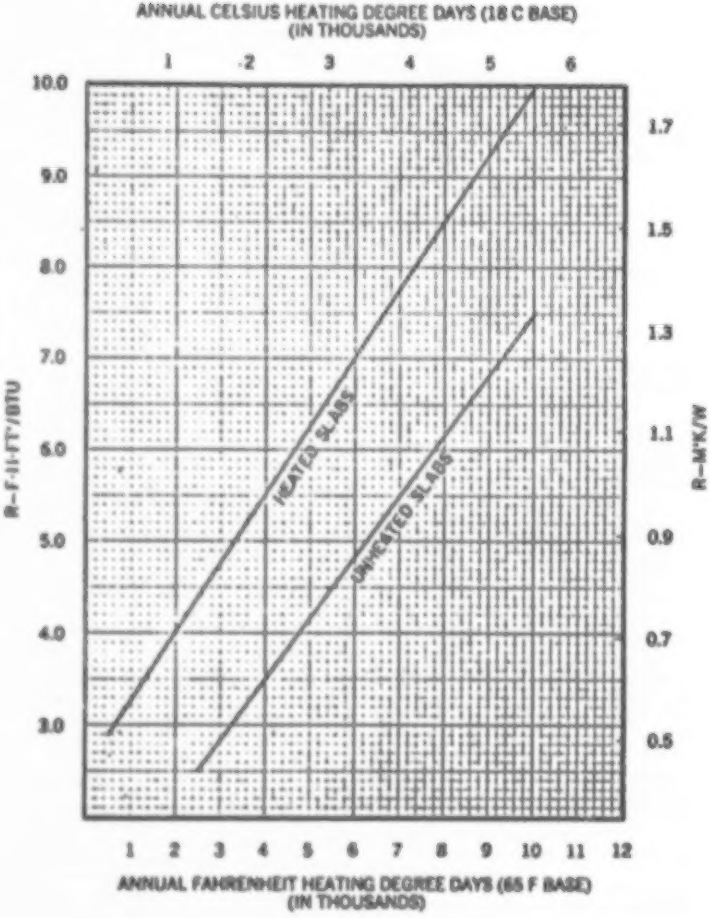


Fig. 3

U_o WALLS—HEATING—TYPE—"B" BUILDING

FOR ALL BUILDINGS NOT COVERED BY PARA. 4.3

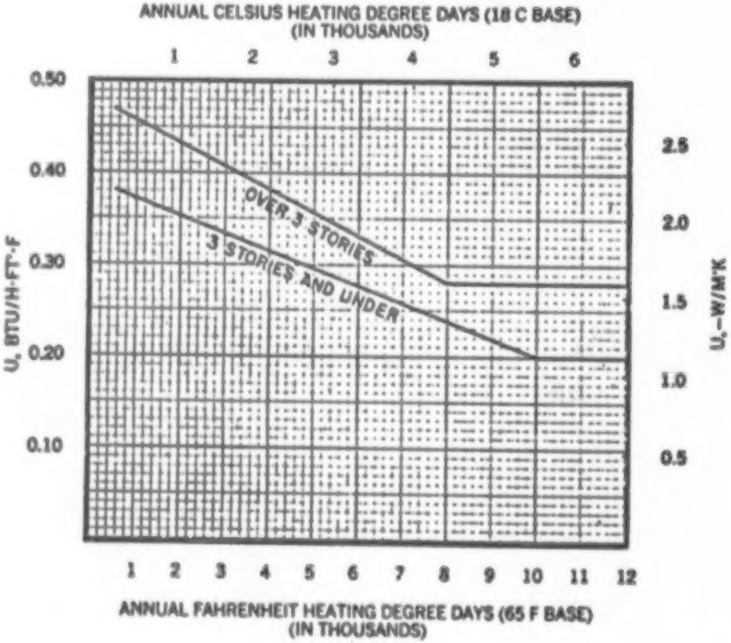


Fig. 4

U$_o$—ROOFS AND CEILINGS

TYPE "B" BUILDINGS

FOR ALL BUILDINGS NOT COVERED BY PARA. 4.3

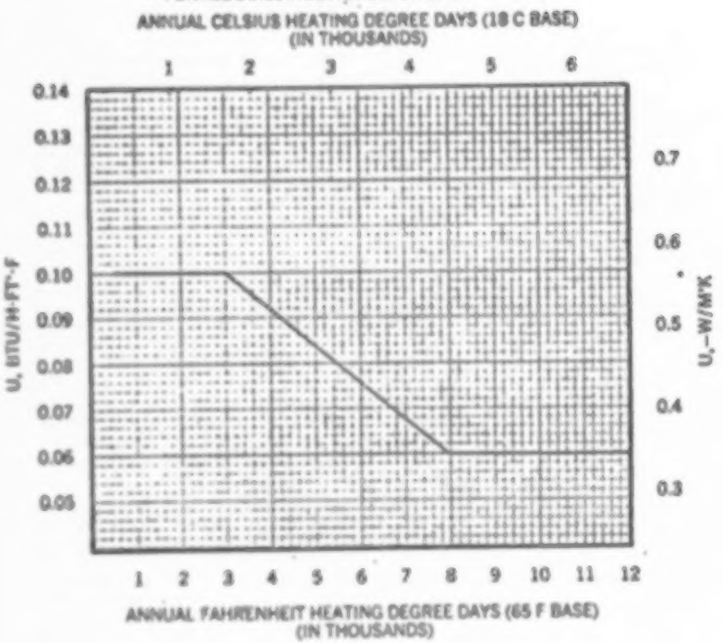
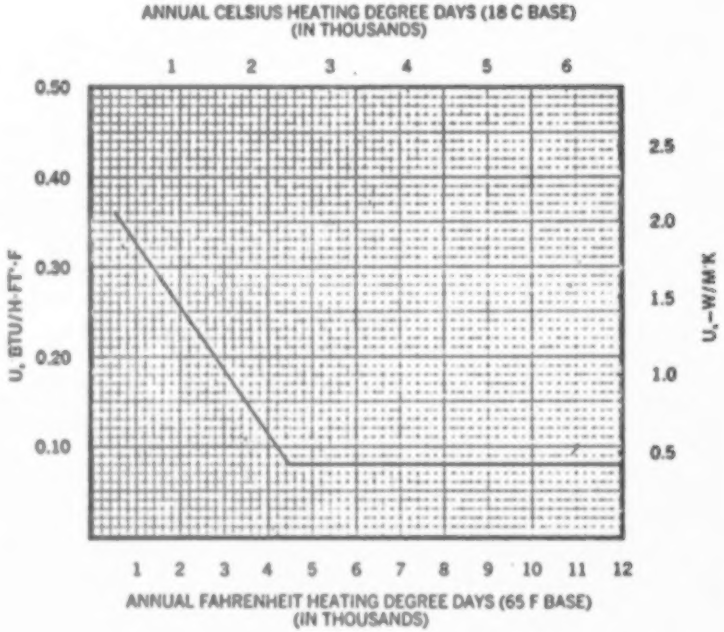


Fig. 5

U$_o$ VALUES—FLOORS OVER UNHEATED SPACES



4.3.2.1.2 The requirements for locations with less than 500 Fahrenheit Heating Degree Days (278 Celsius Heating Degree Days) shall be:

- a. If only heating is provided, there is no U_o requirement.
- b. If the building is to be mechanically cooled when built or if provision is made for the future addition of mechanical cooling, the U_o shall be 0.30 Btu/h · ft² · F (1.70 W/m²K) maximum.

4.3.2.2 Roof/Ceiling. Any building that is heated and/or mechanically cooled shall have a combined thermal transmittance value (U_o value) for roof/ceilings not to exceed 0.05 Btu/h · ft² · F (0.28 W/m²K) for areas with 8,000 Fahrenheit Heating Degree Days (4444 Celsius Heating Degree Days) or less and not to exceed 0.04 Btu/h · ft² · F (0.23 W/m²K) for areas with more than 8,000 Fahrenheit Heating Degree Days (4444 Celsius Heating Degree Days).

EXCEPTION: Roof/ceiling assemblies in which the finished interior surface is essentially the under side of the roof deck, such as a wooden cathedral ceiling, may have a U_o value not to exceed 0.08 Btu/h · ft² · F (0.45 W/m²K) for any Heating Degree Day area.

4.3.2.2.1 Eq. 2 shall be used to determine acceptable combinations to meet the required U_o values.

4.3.2.3 Floors over Unheated Spaces. For floors of heated and/or mechanically cooled spaces over unheated spaces, the U_o value shall not exceed the values shown in Fig. 5.

4.3.2.4 Slab-on-Grade Floors. For slab-on-grade floors, the thermal resistance of the insulation around the perimeter of the floor shall be as shown in Fig. 2. The insulation shall extend downward from the top of the slab for a minimum distance of 24 in. (0.6 m) or downward to the bottom of the slab then horizontally beneath the slab for a minimum total distance of 24 in. (0.6 m).

4.4 Criteria for Type "B" Buildings

4.4.1 Type "B" Buildings shall include all other buildings not covered by the definition of Type "A" Buildings.

4.4.2 Heating Criteria

4.4.2.1 Walls. Any building that is mechanically heated shall have a combined thermal transmittance value (U_o value) for the gross area of exterior walls not exceeding the values shown in Fig. 3, using Heating Degree Days as given in the 1973 ASHRAE HANDBOOK & Product Directory, Systems Volume, Chapter 43*.

4.4.2.1.1 Eq. 1 shall be used to determine acceptable combinations to meet the requirements of Fig. 3.

Equation 1 Formula for Determining Combinations (See Fig. 1 and Section 4.3.2.1.)

$$U_o = \frac{U_{wall} A_{wall} + U_{window} A_{window} + U_{door} A_{door}}{A_o}$$

(See note below.)

where

U_o* = the average thermal transmittance of the gross wall area, Btu/h · ft² · F (W/m²K)

A_o = the gross area of exterior walls, ft² (m²) (see 4.2.2)

U_{wall} = the thermal transmittance of all elements of the opaque wall area, Btu/h · ft² · F (W/m²K)

A_{wall} = opaque wall area, ft² (m²)

U_{window} = the thermal transmittance of the window area, Btu/h · ft² · F (W/m²K)

A_{window} = window area (including sash) ft² (m²)

U_{door} = the thermal transmittance of the door area, Btu/h · ft² · F (W/m²K)

A_{door} = door area, ft² (m²)

NOTE: Where more than one type of wall, window and/or door is used, the U x A term for that exposure shall be expanded into its sub-elements, as:

$$U_{wall_1} A_{wall_1} + U_{wall_2} A_{wall_2}, \text{etc.}$$

4.4.2.2 Roof/Ceiling. Any building that is heated shall have a combined thermal transmittance value (U_o value) for roof/ceilings not exceeding the values shown in Fig. 4 using Heating Degree Days.

4.4.2.2.1 Eq. 2 shall be used to determine acceptable combinations to meet the required U_o values of Fig. 4.*

4.4.2.3 Floors over Unheated Spaces. For floors of heated spaces over unheated areas, the U_o value shall not exceed the values shown in Fig. 5.

4.4.2.4 Slab-on-Grade Floors. For slab-on-grade floors, the thermal resistance of the insulation around the perimeter of the floor shall be as shown in Fig. 2. The insulation shall extend downward from the top of the slab for a minimum distance of 24 in. (0.6 m) or downward to the bottom of the slab then horizontally beneath the slab for a minimum total distance of 24 in. (0.6 m).

4.4.3 Cooling Criteria

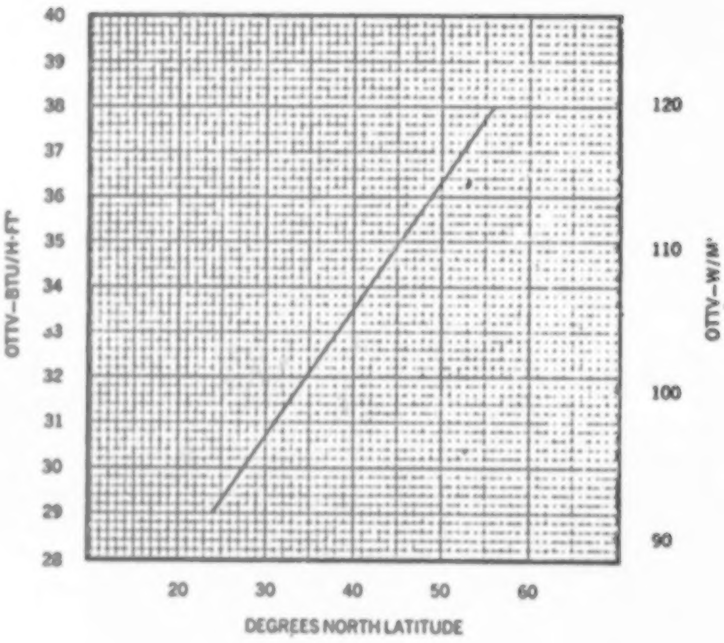
4.4.3.1 Walls. Any building that is mechanically cooled shall have an overall thermal transfer value,

*Fig. 1 for Type "A" Buildings, Fig. 3 for Type "B" Buildings.

Fig. 6

OVERALL THERMAL TRANSFER VALUE WALLS COOLING TYPE "B" BUILDING

FOR ALL BUILDINGS NOT COVERED BY PARA. 4.3



OTTV, for the gross area of exterior walls not exceeding the values shown in Fig. 6 in Btu/h · ft² (W/m²).

4.4.3.1.1 Eq 3 shall be used to determine acceptable combinations to meet the requirements of Fig. 6.

4.4.3.2 Roof Cooling. Any building that is mechanically cooled shall have a combined thermal transmittance value (U_o value) for roof/ceilings not to exceed that which would be determined by the heating criteria above. (See 4.3.2.2.)

4.5 Air Leakage – All Buildings

4.5.1 The requirements of this section are limited to those locations separating outdoor ambient conditions from interior building conditioned air space and are not applicable to the separation of interior conditioned spaces from each other.

4.5.2 Compliance with the criteria for air leakage shall be determined by ASTM E 283-73[9], Standard Method of Test for Rate of Air Leakage through Exterior Windows, Curtain Walls and Doors, at a pressure differential of 1.567 lb/ft² (75 Pa), which is equivalent to the effect of a 25 mph (11.1 m/s) wind.

4.5.3 Requirements

4.5.3.1 Windows (ANSI A134.1[10]; NWMA IS-2[11]; MHMA 1-71[12]). Windows *shall* be designed to limit air leakage; the air infiltration rate *shall not* exceed 0.5 ft³/min per foot (0.77 dm³/s per meter) of sash crack. (See 4.5.1.)

4.5.3.2 Sliding Glass Doors (Residential Patio Type) (ANSI A134.2[13]; NWMA IS-3[14]; MHMA 1-71[12]). Sliding glass doors of this type *shall* be designed to limit air leakage; the air infiltration rate *shall not* exceed 0.5 ft³/min per square foot (2.5 dm³/s per square meter) of door area. (See 4.5.1.)

4.5.3.3 Entrance Swinging Doors for Residential Use (Residential use only as a means of egress or ingress to living units) (MHMA 3-74[15]). Entrance swinging doors used for egress or ingress from residential living units *shall* be designed to limit air leakage; the air infiltration rate *shall not* exceed 1.25 ft³/min per square foot (6.35 dm³/s per square meter) of door area. (See 4.5.1.)

4.5.3.4 Swinging, Revolving or Sliding Doors for Other Than Residential Use. These *shall* be designed to limit air leakage; the air infiltration rate *shall not* exceed 11 ft³/min per linear foot (17 dm³/s per linear meter) of door crack. (See 4.5.1.)

4.5.4 Caulking and Sealants. Exterior joints around windows and door frames, between wall cavities and window or door frames, between wall and foundation, between wall and roof, between wall panels, at penetrations or utility services through walls, floors and roofs, and all other openings in the exterior envelope *shall* be caulked, gasketed, weatherstripped, or otherwise sealed.

Equation 2 Formula for Determining Roof/Ceiling Combinations (See Section 4.3.2.2.)

$$U_o = \frac{U_{roof}A_{roof} + U_{skylight}A_{skylight}}{A_o}$$

(See note below)

where

U_o = the average thermal transmittance of the gross roof/ceiling area, Btu/h · ft² · F (W/m²K)

A_o = the gross area of a roof/ceiling assembly, ft² (m²) (see 4.2)

U_{roof} = the thermal transmittance of all elements of the opaque roof/ceiling area, Btu/h · ft² · F (W/m²K)

A_{roof} = opaque roof/ceiling area, ft² (m²)

$U_{skylight}$ = the thermal transmittance of all skylight elements in the roof/ceiling assembly, Btu/h · ft² · F (W/m²K)

$A_{skylight}$ = skylight area (including frame) ft² (m²)

NOTE: Where more than one type of roof/ceiling and/or skylight is used, the U x A term for that exposure *shall* be expanded into its sub-elements, as:

$$U_{roof_1} A_{roof_1} + U_{roof_2} \cdot A_{roof_2} \cdot \text{etc.}$$

Equation 3

$$OTTV = \frac{(U_w \times A_w \times TD_{EQ}) + (A_f \times SF \times SC) + (U_f \times A_f \times \Delta T)}{A_o}$$

(See note below.)

OTTV = overall thermal transfer value

where

U_w = the thermal transmittance of all elements of the opaque wall area Btu/h · ft² · F (W/m²K)

A_w = opaque wall area, ft² (m²)

U_f = the thermal transmittance of the fenestration area Btu/h · ft² · F (W/m²K)

A_f = fenestration area, ft² (m²)

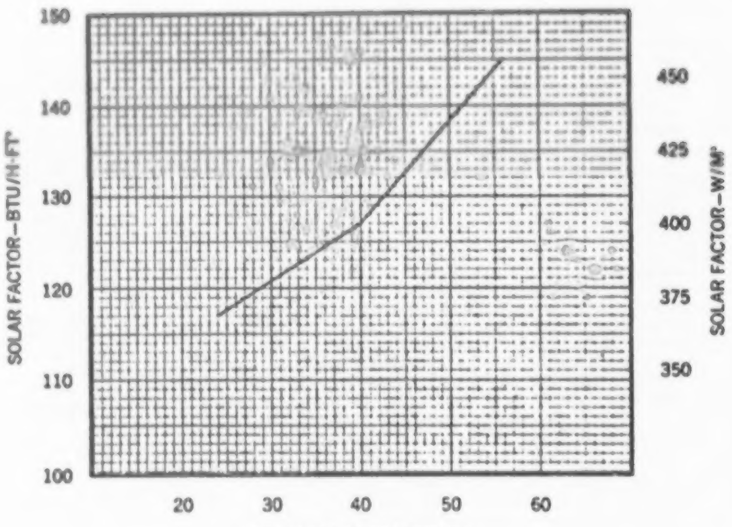
TD_{EQ} = value given in the table below, F (°C)

SC = shading coefficient of the fenestration

Fig. 7

SOLAR FACTOR (SF) VALUES

FOR USE IN EQUATION 3



ΔT = temperature difference between exterior and interior design conditions, F (see 4.2.5)

SF = solar factor value given Btu/h · ft² (W/m²) (see Fig. 7)

A_0 = gross area of exterior walls, ft² (m²) (see 4.2.2)

NOTE: Where more than one type of wall and/or fenestration is used, the respective term or terms *shall* be expanded into sub-elements, as:

$(U_w \times A_w \times TD_{EQ}) + (U_{w_2} \times A_{w_2} \times TD_{EQ_2})$, etc.

References Used in Section 4

1-6 ASHRAE HANDBOOK OF FUNDAMENTALS, Chapters 17-22, ASHRAE, New York, NY, 1972.

7 ASHRAE HANDBOOK OF FUNDAMENTALS, Chapter 32, ASHRAE, New York, NY, 1972.

8 ASHRAE HANDBOOK & Product Directory, Systems Volume, Chapter 43, ASHRAE, New York, NY, 1973.

9 ASTM E283-73, Standard Method Test for Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors, ASTM, Philadelphia, PA, 1973.

10 ANSI A134.1 "Specifications for Aluminum Windows," ANSI, New York, NY, 1972.

5.0 HEATING, VENTILATING AND AIR-CONDITIONING (HVAC) SYSTEMS

5.1 General.

This section establishes HVAC system requirements for effective utilization of energy. System criteria developed from the requirements of this section may influence the type of system that is furnished with the equipment selected in accordance with Section 6. It is recommended that the HVAC system(s) selection process include an annual energy use evaluation.

5.2 Scope

This section covers determination of heating and cooling loads, design requirements, and control requirements for general comfort applications in new buildings where normally clothed people are engaged in sedentary or near-sedentary activities. Criteria are established for insulating HVAC systems and for duct construction.

EXCEPTIONS. Special applications, such as but not limited to hospitals, laboratories, thermally sensitive equipment, computer rooms and supermarkets, are exempt from the requirements of this section. Where these special applications are described in the 1974 ASHRAE HANDBOOK & Product Directory, Applications Volume⁸, the criteria described therein *should* be used.

TABLE FOR TEMPERATURE DIFFERENCE

Wall Construction – mass per unit area		TD_{EQ}	
lbs/ft²	kg/m²	F	C
0 – 25	0 – 125	44	24.5
26 – 40	126 – 195	37	21.0
41 – 70	196 – 345	30	17.0
71 and above	346 and above	23	13.0

Weight of wall construction *shall* be determined from the 1972 ASHRAE HANDBOOK OF FUNDAMENTALS, Chapter 22[16].

11 NWMA IS-2

12 MHMA 1-71

13 ANSI A134.2 "Specifications for Aluminum Sliding Glass Doors," ANSI, New York, NY, 1972.

14 NWMA IS-3

15 MHMA 3-74

16 ASHRAE HANDBOOK OF FUNDAMENTALS, Chapter 22, ASHRAE, New York, NY, 1972.

5.3 Calculation of Heating and Cooling Loads

5.3.1 Calculation Procedures. Heating and cooling design loads for the purpose of sizing HVAC systems *shall* be determined in accordance with one of the procedures described in the 1972 ASHRAE HANDBOOK OF FUNDAMENTALS, Chapters 21[3] and 22[3], or an equivalent computation procedure.

The procedures in Section 4 of this Standard are used for determining the thermal design of the exterior envelope and are not considered equivalent for the purpose of sizing.

For equivalent procedures for residential buildings, see Appendix I. The design parameters in 5.3.2.1 through 5.3.2.4 *shall* apply for all computational methods.

5.3.2 Design Parameters. The following design parameters *shall* be used for HVAC system design load calculations for general comfort applications:

5.3.2.1 Outdoor Design Conditions. Winter and summer outdoor design conditions *shall* be selected for listed locations in Chapter 33 of the 1972 ASHRAE HANDBOOK OF FUNDAMENTALS[4] from the columns of 97½ percent values for winter and 2½ percent values for summer. *Adjustments may be made to reflect local climates which differ from the ASHRAE-tabulated temperatures, or local weather experience may be used for locations not listed.*

5.3.2.2 Indoor Design Conditions

Winter

The *recommended* design condition is 72F (22°C) dry bulb. If humidification is provided, it *shall* be designed to a *maximum* relative humidity of 30 percent.

Summer

Where comfort air conditioning is required or used, the *recommended* indoor design condition is 78F (25.5°C) dry bulb. The actual design relative humidity within the comfort envelope as defined in ASHRAE Standard 55-74 "Thermal Environmental Conditions for Human Occupancy"[5] *shall* be selected for minimum total HVAC system energy use.

Although the *recommended* design points are established above, the HVAC system design *should* permit operating at minimum energy levels within the boundaries of the comfort envelope.

Due to internal heat gains or losses, it *may* be more energy efficient to operate at other than the design points for major portions of the year.

5.3.2.3 Ventilation. Ventilation air *shall* conform to ASHRAE Standard 62-73 "Natural and Mechanical Ventilation."[6]

The *minimum* column value for each type of occupancy *shall* be used for design. The ventilation quantities tabulated in Section 6 of ASHRAE Standard 62-73 are for 100 percent outdoor air ventilating systems. Section 5 of ASHRAE Standard 62-73 permits a reduction to 33 percent of the specified minimum outdoor air requirement for recirculating HVAC systems.

EXCEPTIONS. If outdoor air quantities other than those shown in ASHRAE Standard 62-73 are used or required because of special occupancy or process requirements, source control of air contamination, or conflicting codes, the required outdoor air quantities *shall* be used as the basis of calculating the heating and/or cooling design loads.

5.3.2.4 Infiltration. Infiltration for heating and cooling design loads *shall* be calculated by the procedures in the 1972 ASHRAE HANDBOOK OF FUNDAMENTALS[7]. For one- and two-family residential buildings the methods contained in the manuals listed in Appendix I *may* be used.

5.4 Controls

5.4.1 Temperature Control. Each HVAC system *shall* be provided with at least one thermostat for the regulation of temperature. Each thermostat *shall* be capable of being set as follows:

a. Where used to control heating only – 55 to 75F (13 to 24°C)
b. Where used to control cooling only – 70 to 85F (21 to 29°C)
c. Where used to control both heating and cooling, it *shall* be capable of being set from 55 to 85F (13 to 29°C) and *shall* be capable of operating the system heating and cooling in sequence. It *shall* be adjustable to provide a temperature range of up to 10F (5.5°C) between full heating and full cooling, *except* as allowed in 5.5.6.b.

5.4.2 Humidity Control. If an HVAC system is equipped with a means for adding moisture to maintain specific selected relative humidities in spaces or zones, a humidistat *shall* be provided. This device *shall* be capable of being set to prevent new energy from being used to produce space relative humidity above 30 percent rh. Where a humidistat is used in an HVAC system for controlling moisture removal to maintain specific selected relative humidities in spaces or zones, it *shall* be capable of being set to prevent new energy from being used to produce a space relative humidity below 60 percent rh.

5.4.3 Zoning for Temperature Control

5.4.3.1 One- and Two-Family Dwelling Units, Attached or Detached, and Mobile Homes. At least one thermostat for regulation of space temperature *shall* be provided for each separate HVAC system. In addition, a readily accessible manual or automatic means *shall* be provided to partially restrict or shut off the heating and/or cooling input to each zone or floor.

EXCEPTION. Nonconditioned basements and garages.

5.4.3.2 Multi-Family Dwelling Units. For multi-family dwelling units, each individual dwelling unit *shall* be considered separately and *shall* meet the requirements of 5.4.3.1. Spaces other than living units *shall* meet the requirements of 5.4.3.3.

5.4.3.3 All Other Types of Buildings or Occupancies. At least one thermostat for regulation of space temperature *shall* be provided for:

a. Each separate HVAC system.
b. Each separate zone as defined in Section 3. As a minimum each floor of a building *shall* be considered as a separate zone. On a multi-story building where the perimeter system offsets only the transmission losses of the exterior wall, an entire side of uniform exposure *may* be zoned separately. A readily accessible manual or automatic means *shall* be provided to partially restrict or

shut off the heating and/or cooling input (for the exposure) to each zone.

5.4.4 Control Setback and Shutoff

5.4.4.1 One- and Two-Family and Multi-Family Dwelling Units, Attached or Detached, and Mobile Homes. The thermostat required in 5.4.3.1 and 5.4.3.2, or an alternate means such as a switch or clock, *shall* provide a readily accessible, manual or automatic means for reducing the energy required for heating and cooling during periods of non-use or reduced need such as but not limited to unoccupied periods and sleeping hours. Lowering thermostat set points to reduce energy consumption of heating systems *shall not* cause energy to be expended to reach the reduced setting.

5.4.4.2 Other Buildings and Occupancies. Each HVAC system *shall* be equipped with a readily accessible means of shutting off or reducing the energy used for HVAC during periods of non-use or alternate uses of the building spaces or zones served by the system. The following are examples that meet this requirement:

- a. Manually adjustable automatic timing devices
- b. Manual devices for use by operating personnel
- c. Automatic control systems

5.5 Simultaneous Heating and Cooling

Systems that employ both heating and cooling simultaneously in order to achieve comfort conditions within a space are inherently inefficient in utilization of energy. Their use is discouraged. Selection of such systems *shall be limited* to those situations where more efficient methods of heating and air conditioning can not be effectively utilized to meet system objectives. Separate systems should be considered to serve areas of the building with substantially different heating/cooling load characteristics (for example, the perimeter space as compared to the interior space). Simultaneous heating and cooling by reheating or recooling supply air or by concurrent operation of independent heating and cooling systems serving a common zone *shall* be restricted as delineated below.

5.5.1 Recovered energy, provided the new energy expended in the recovery process is less than the amount recovered, *may* be used for control of temperature and humidity. *New energy is defined as energy, other than recovered, utilized for the purpose of heating or cooling.*

5.5.2 New energy *may* be used, when necessary, to prevent relative humidity from rising above 60 percent for comfort control or to prevent condensation on terminal units or outlets.

5.5.3 New energy *may* be used for control of temperature if minimized as delineated in 5.5.4 through 5.5.8.

5.5.4 Reheat Systems. Systems employing reheat and serving multiple zones, other than those employing *variable air volume* for temperature control, *shall* be provided with control that will automatically reset the system cold air supply to the highest temperature level that will satisfy the zone requiring the coolest air. *Single zone* reheat systems *shall* be controlled to sequence reheat and cooling.

5.5.5 Dual Duct and Multi-Zone Systems. These systems shall be provided with control that will automatically reset (a) the cold deck air supply to the highest temperature that will satisfy the zone requiring the coolest air and (b) the hot deck air supply to the lowest temperature that will satisfy the zone requiring the warmest air.

5.5.6 Recooling Systems. Systems in which heated air is recooled, directly or indirectly, to maintain space temperature *shall* be provided with control that will automatically reset the temperature to which the supply air is heated to the lowest level that will satisfy the zone requiring the warmest air.

5.5.7 For systems with multiple zones, one or more zones may be chosen to represent a number of zones with similar heating/cooling characteristics. A multiple zone HVAC system that employs reheating or recooling for control of not more than 5,000 ft³/min (2.36 m³/s) or 20 percent of the total supply air of the system, whichever is less, *shall* be exempt from the supply air temperature reset requirement of 5.5.4 through 5.5.6.

5.5.8 Concurrent operation of independent heating and cooling systems serving common spaces and requiring the use of new energy for heating or cooling *shall* be *minimized* by one or both of the following:

- a. By providing sequential temperature control of both heating and cooling capacity in each zone
- b. By limiting the heating energy input through automatic reset control of the heating medium temperature (or energy input rate) to only that necessary to offset heat loss due to transmission and infiltration and, where applicable, to heat the ventilation air supply to the space

5.6 Cooling with Outdoor Air (Economizer Cycle)

Each fan system *shall* be designed to use up to and including 100 percent of the fan system capacity for cooling with outdoor air automatically whenever its use will result in lower usage of new energy. (See 5.5.1 for definition of new energy.) Activation of economizer cycle *shall* be controlled by sensing outdoor air enthalpy and dry-bulb temperature jointly or outdoor air dry-bulb temperature alone to accomplish the above.

EXCEPTIONS. Cooling with outdoor air is *not required* under any one or more of the following conditions:

- a. Fan system capacity less than 5,000 ft³/min (2.36 m³/s) or 134,000 Btu/h (39.3 kW) total cooling capacity.
- b. The quality of the outdoor air (as defined in Table 1 of ASHRAE Standard 62-73[8]) is so poor as to require extensive treatment of the air.
- c. The need for humidification and/or dehumidification requires the use of more energy than is conserved by outdoor air cooling.
- d. The use of outdoor air cooling may affect the operation of other systems (such as return or exhaust air fans or supermarket refrigeration) so as to increase the overall energy consumption of the building.
- e. Internal/external zone heat recovery or other energy recovery is used.
- f. Annual Fahrenheit Heating Degree Days are less than 2500 (1390°C).
- g. When all space cooling is accomplished by a circulating liquid which transfers space heat directly or indirectly to a heat rejection device such as a cooling tower without the use of a refrigeration system.

5.7 Mechanical Ventilation

Each mechanical ventilation system (supply and/or exhaust) *shall* be equipped with a readily accessible means for either shutoff or volume reduction and shutoff when ventilation is not required.

5.8 Energy for Air Delivery

The air transport factor for each all-air HVAC system *shall not* be less than 4.0. The factor *shall* be based on design system air flow for constant volume systems. The factor for variable air volume systems *may* be based on average conditions of operation. Energy for transfer of air through heat recovery devices *shall not* be included in determining the factor; *however*, such energy *shall* be included in the evaluation of the effectiveness of the heat recovery system.

$$\text{Air Transport Factor} = \frac{\text{Space Sensible Heat Removal}^{*}}{(\text{Supply} + \text{Return Fan(s) Power Input})^{*}}$$

*Expressed in either Btu/h (W)

5.9 Energy Recovery

It is *recommended* that consideration be given to the use of recovery systems which will conserve energy (provided the amount expended is less than the amount recovered) when the energy transfer potential and the operating hours are considered.

5.10 Piping Insulation

All piping installed to serve buildings and within buildings *shall* be thermally insulated in accordance with Table 5.1, except as stated in 5.10.3 (For service water heating systems see Section 7.)

5.10.1 Other Insulation Thicknesses. Insulation thicknesses in Table 5.1 are based on insulation having thermal resistances in the range of 4.0 to 4.6 h · F · ft²/Btu per inch (28 to 32 m²K/W per meter) of thickness on a flat surface at a mean temperature of 75F (24°C). Minimum insulation thickness *shall* be increased for materials having R values less than 4.0 h · F · ft²/Btu per inch (28 m²K/W per meter) of thickness or *may* be reduced for materials having R values greater than 4.6 h · F · ft²/Btu per inch (32 m²K/W per meter) of thickness.

- a. For materials with thermal resistance greater than R = 4.6 h · F · ft²/Btu per inch (32 m²K/W per meter) of thickness, the minimum insulation thickness *may* be reduced as follows:

  In English units:

  $$\frac{4.6 \times \text{Table 5.1 Thickness}}{\text{Actual R}} = \text{New Minimum Thickness}$$

  In SI Units:

  $$\frac{32 \times \text{Table 5.1 Thickness}}{\text{Actual R}} = \text{New Minimum Thickness}$$

- b. For materials with thermal resistance less than R = 4.0 h · F · ft²/Btu per inch (28 m²K/W per meter) of thickness, the minimum insulation thickness *shall* be increased as follows:

  In English units:

  $$\frac{4.0 \times \text{Table 5.1 Thickness}}{\text{Actual R}_{\text{I}}} = \text{New Minimum Thickness}$$

  In SI Units:

  $$\frac{28 \times \text{Table 5.1 Thickness}}{\text{Actual R}} = \text{New Minimum Thickness}$$

5.10.2 The required thermal resistances do not consider condensation. Additional insulation with vapor barriers *may* be required to prevent condensation under some conditions.

EXCEPTIONS. Piping insulation is not required in any of the following cases:

- a. Piping installed within HVAC equipment
- b. Piping at temperatures between 55F and 120F (13 to 49°C)
- c. When the heat loss and/or heat gain of the piping, without insulation, does not increase the energy requirements of the building
- d. Piping installed in basements, cellars or unventi-

Table 5.1

Minimum Pipe Insulation

Piping System Types	Fluid Temperature Range		Insulation Thickness for Pipe Sizes*											
			Runouts Up to 2 in.**		1 in. and Less		1¼–2		2½–4		5 & 6		8 in. and Larger	
	F	°C	in.	cm.	in.	cm.	in.	cm.	in.	cm.	in.	cm.	in.	cm.
Heating Systems Steam & Hot Water														
High Pressure Temp	306–450	152–238	1.5	3.8	1.5	3.8	2.0	5.1	2.5	6.4	3.5	8.9	3.5	8.9
Medium Pressure Temp	251–305	122–151	1.5	3.8	1.5	3.8	2.0	5.1	2.5	6.4	3.0	7.6	3.0	7.6
Low Pressure Temp	201–250	94–121	1.0	2.5	1.0	2.5	1.5	3.8	1.5	3.8	2.0	5.1	2.0	5.1
Low Temperature	120–200	49–93	0.5	1.3	0.75	1.9	1.0	2.5	1.0	2.5	1.0	2.5	1.5	3.8
Steam Condensate (for Feed Water)	Any	Any	1.0	2.5	1.0	2.5	1.0	2.5	1.5	3.8	1.5	3.8	2.0	5.1
Cooling Systems														
Chilled Water,	40–55	4.5–13	0.5	1.3	0.5	1.3	0.75	1.9	1.0	2.5	1.0	2.5	1.0	2.5
Refrigerant, or Brine	Below 40	Below 4.5	1.0	2.5	1.0	2.5	1.5	3.8	1.5	3.8	1.5	3.8	1.5	3.8

*See 5.10.1 and 5.10.2 (Pipe sizes are nominal dimensions.)

**Runouts to Individual Terminal Units (not exceeding 12 ft (3.7 m) in length)

lated crawl spaces with insulated walls in one- and two-family dwellings

5.11 Air Handling Duct System Insulation

All ducts, plenums and enclosures installed in or on buildings shall be thermally insulated as follows:

5.11.1 All duct systems, or portions thereof, shall be insulated to provide a thermal resistance, excluding film resistances, of

$$R = \frac{\Delta t}{15}\ h \cdot F \cdot ft^2/Btu\ \left(R = \frac{\Delta t}{47.3}\ m^2K/W\right)$$

where Δt = the design temperature differential between the air in the duct and the surrounding air in F (K).

EXCEPTIONS: Duct insulation is not required in any of the following cases:

- a. Where Δt is 25F (14K) or less
- b. Supply or return air ducts installed in basements, cellars or uninsulated crawl spaces with insulated walls in one- and two-family dwellings
- c. When the heat gain or loss of the ducts, without insulation, will not increase the energy requirements of the building
- d. Within HVAC equipment
- e. Exhaust air ducts

5.11.2 Uninsulated ducts in uninsulated sections of exterior walls and in attics above the insulation might not meet the requirements of this Standard.

5.11.3 The required thermal resistances do not consider condensation. Additional insulation with vapor barriers may be required to prevent condensation under some conditions.

5.12 Duct Construction

All ductwork shall be constructed and erected in accordance with Chapter 1 of the 1975 ASHRAE HANDBOOK & Product Directory, Equipment Volume[8] or the following NESCA/SMACNA or SMACNA standards:

- a. Residential Heating and Air Conditioning Systems – Minimum Installation Standards, August 1973, NESCA/SMACNA[9]
- b. Low Velocity and Duct Construction Standards, 4th edition, 1969[10]
- c. High Velocity Duct Construction Standards, 2nd edition, 1969[11]
- d. Fibrous Glass Duct Construction Standards, 3rd edition, 1972[12]
- e. Pressure Sensitive Tape Standards, 1973 (for fibrous glass ducts only)[13]

5.12.1 High-pressure and medium-pressure ducts *shall* be leak tested in accordance with the applicable SMACNA Standard, with the rate of leakage *not to exceed* the maximum rate specified in that standard.

5.12.2 There is no standard at this time for leak testing of low pressure ducts. When low pressure supply air ducts are located outside of the conditioned space (except return air plenums), all transverse joints *shall* be sealed using mastic or mastic plus tape. For fibrous glass ductwork, pressure sensitive tape is acceptable.

5.12.3 There is no standard at this time for damper leakage. Automatic or manual dampers installed for the purpose of shutting off outside air intakes for ventilation air *shall* be designed with tight shut-off characteristics to minimize air leakage.

5.13 Balancing

The HVAC system design *shall* provide means for balancing the air and water systems such as but not limited to dampers, temperature and pressure test connections and balancing valves.

References Used in Section 5

[1] ASHRAE HANDBOOK & Product Directory, Applications Volume, ASHRAE, New York, NY, 1974.

[2] ASHRAE HANDBOOK OF FUNDAMENTALS, Chapter 21, ASHRAE, New York, NY, 1972.

[3] ASHRAE HANDBOOK OF FUNDAMENTALS, Chapter 22, ASHRAE, New York, NY, 1972.

[4] ASHRAE HANDBOOK OF FUNDAMENTALS, Chapter 33, ASHRAE, New York, NY, 1972.

[5] ASHRAE Standard 55-74 "Thermal Environmental Conditions For Human Occupancy," ASHRAE, New York, NY, 1974.

[6] ASHRAE Standard 62-73 "Natural and Mechanical Ventilation," ASHRAE, New York, NY, 1973.

[7] ASHRAE HANDBOOK OF FUNDAMENTALS, ASHRAE, New York, NY, 1972.

[8] ASHRAE HANDBOOK & Product Directory, Equipment Volume, ASHRAE, New York, NY, 1975.

[9] "Residential Heating and Air Conditioning Systems – Minimum Installation Standards," NESCA, SMACNA, Aug., 1973.

[10] "Low Velocity and Duct Construction Standards," 4th ed., SMACNA, Washington, DC, 1969.

[11] "High Velocity Duct Construction Standards," 2nd edition, SMACNA, Washington, DC, 1969.

[12] "Fibrous Glass Duct Construction Standards," 3rd edition, SMACNA, Washington, DC, 1972.

[13] "Pressure Sensitive Tape Standards," SMACNA, Washington, DC, 1973.

FOOTNOTES

1. Battelle Columbus and Pacific Northwest Laboratories, (1973) *Environmental Considerations in Future Energy Growth*, Volume 1, for the Office of Research and Development, Environmental Protection Agency, page 603.

2. This table was presented to Congress by the Federal Energy Administration as part of "A Legislative Impact Statement for Title X - Building Energy Conservation Standards Act of 1975." This report was prepared by Hittman Associates, Inc., Columbia, Maryland, and is referred to hereafter as Hittman, *Title X*.

3. For specification of design characteristics for the building types in question, see Appendix III-A.

4. Personal communication, M. Alford with J. Reed and T. Eleriza of Hittman Associates, Inc., November 1975.

5. D.C. Chan, *Residential Energy Consumption and Small Scale Options of Energy Systems for Space Heating*, NTIS: PB 239-941, November 1974. This conversion efficiencies may be high. More realistic figures are generally quoted as 70% for gas and 60% for oil, but use of the higher figures yields more conservative results.

6. The BTU content of fuels is taken as 1,021 BTU/cubic foot for gas, 138,690 BTU/gallon of distillate fuel oil, and 3,412 BTU kilowatt hour of electricity. Source: "Monthly Energy Review," Federal Energy Administration, Washington, D.C., October 1975.

7. Hittman Associates, Inc., *Environmental Impacts, Efficiency and Cost of Energy Supply and End Use*, Volume 1, 1974.

8. Battelle, *op.cit.*, p. 603.

9. Hittman, *Title X*, p. 19.

10. Electricity conversion rates: Fossil fuel steam/electric, coal--10,176 BTU/kilowatt hour. "Monthly Energy Review," Federal Energy Administration, Washington, D.C.

11. Hittman Associates, Inc., *Residential Energy Consumption, Multi-Family Housing*, Washington, D.C.: GPO, 1974. (referred to hereafter as Hittman, *Multi-Family Housing*)

12. Hittman, *Title X*.

13. Briggs, et al., Air Pollution Considerations in Residential Planning Volume I: Manual, prepared for EPA and HUD, July 1974.

14. Department of Housing and Urban Development, Federal Housing Administration, Minimum Property Standards for One and Two Family Dwellings, Revision 1, July 1974.

15. A study conducted by the Harvard Graduate School of Design for the National Science Foundation found that the conversion of vacation homes to year round use was a major phenomenon on the South Shore of Massachusetts, and caused considerable environmental problems; vacation homes often require considerably upgrading to make them suitable for year-round use.

16. Hittman, Multi-Family Housing.

17. This "characteristic house" is fully defined in Hittman, Single Family Housing: it is a two story building with four bedrooms, two and a half baths, and a net floor area of 1695 square feet.

18. An average figure based on statements in Hittman, Title X, as well as on figures contained in Abt Associates, In the Bank or Up the Chimney.

19. FEA, "Monthly Energy Review."

20. Abt Associates, In the Bank or Up the Chimney?, HUD, Washington, D.C., 1975.

21. U.S. Census of Housing.

22. Present value calculations discount future expenditures back to the present by the use of an interest rate; the concept of present value is generally accepted by economists as the most useful way to compare the value of money across time.

23. See Table III-7. Oil valued at $0.35 per gallon.

24. Estimates of future relative price increases of fossil fuels are little more than guesses: the assumption of fuel costs doubling in real terms by 2000 is taken from Hittman Associates, Technology Assessment of Residential Energy Innovations, FEA, 1975.

25. Inflation rates have been much higher over the past few years; 3% is taken as a conservative estimation of inflation over the long term.

26. Musgrave and Musgrave, Public Finance in Theory and Practice, McGrow-Hill, 1973.

27. The following examples are taken from Hittman Associates, Technology Assessment of Residential Energy Innovations, May 1975.

28. Hittman, Multi-Family Housing.

29. The occupancy permit approach has been used in University City, Missouri--a St. Louis suburb. "Occupancy Permits Provide an Older Suburb with an Anti-Blight Tool," Journal of Housing, National Association of Housing and Redevelopment Officials, December 1975.

30. A preliminary analysis of demand elasticity for these improvements indicated that a twenty-five percent tax rebate would stimulate a doubling of the rate of installation by single-family homeowners. Hittman Associates, Inc., Elasticity of Demand to Retrofit as a Function of a Tax Credit, FEA, December 1974.

31. Arthur D. Little, Residential and Commercial Energy Use Patterns 1970-1990, Washington, D.C. 1974.

32. Rates used were 3.520/d.u. for single family detached houses, 3.330/d.u. for low-rise (walk-up) apartments and townhouses, and 2.825/d.u. for high rise units. Source: Real Estate Research Corporation, The Costs of Sprawl, prepared for the Council on Environmental Quality, the Environmental Protection Agency, and the Department of Housing and Urban Development, Washington, D.C., April 1974.

33. John Lansing and Gary Hendricks, Automobile Ownership and Residential Density, Ann Arbor, Survey Research Center, University of Michigan, June 1967, p. 104.

34. Department of Housing and Urban Development, Minimum Property Standards for One and Two Family Dwellings, Revision 1, July 1974.

35. Hittman, Multi-Family Housing.

SECTION IV

ON-SITE WASTEWATER DISPOSAL

ENVIRONMENTAL IMPACTS OF ON-SITE DISPOSAL

Background

Although there are several technologies available for the on-site disposal of sewage, by far the most widespread is the septic tank system. The septic tank is similar to many ancient systems of disposal, traceable as far back as 2550 B.C.,[1] but its modern form is attributed to John Louis Mouras of France, who patented his invention in 1881. A two-chamber septic tank was invented by Philbrick and patented in the United States two years later. Government publications on septic tank disposal systems began to appear in this country in the 1910s and 1920s, and an important advance in the design of disposal fields for tank effluent was made by Henry Rypon in 1928 with his introduction of the percolation test to rationalize field sizing and location. This procedure remains as the principle field test used today to evaluate soil suitability for septic tank installations.

The first significant proliferation in the use of septic tanks came in the 1930's, when the rural electrification program permitted the widespread installation of modern plumbing systems based on pressurized water supplies.[2] But it was during the great suburban expansion of the 1950's and 1960's that septic tanks became a major solution to residential wastewater disposal nationwide: small municipalities on the outskirts of major cities had neither the incentive nor the financial resources to construct centralized sewer systems.[3]

The septic tank system was a technological advance in rural areas, blurring the old distinctions between urban and rural society: it matched the service characteristics of a centralized urban sewerage system--reliability of service and provision of plumbing amenities--at low cost and with easy installation and little maintenance. Developers liked both its amenity value and the ease with which costs and responsibility could be passed on to the homebuyers.

Data from the 1970 Census of Housing shows that nearly twenty-nine percent of the population of the United States is not served by conventional sewers[4] (see Tables 18 through 20). About fifty-nine million people use septic tanks or some other method of on-site disposal; approximately one-half million new systems were being put into service annually in 1971.[5]

Table 18

Housing Units and Population Served by Sewers and On-lot Sewage Disposal Systems in the United States*

Sewage Disposal	Housing Units Served	Population Served+
Public Sewer	48,187,675	144,625,187
Septic Tank or Cesspool	16,601,792	49,826,792
Other	2,904,375	8,716,872
Total	67,693,842	203,168,851

*SOURCE: 1970 Census of Housing
+Assumed average occupancy per housing unit = 3.0.

Table 19

Housing Units and Population Served by Sewers and On-lot Sewage Disposal Systems in Rural and Urban Areas*

	Housing Units Served		Population Served+	
Sewage Disposal	Rural Farm & Nonfarm	Urban	Rural Farm & Nonfarm	Urban
Public Sewer	3,291,284	44,896,391	9,878,098	134,747,089
Septic Tank or Cesspool	11,810,459	4,791,333	35,446,612	14,380,180
Other	2,591,979	312,396	7,779,281	937,590
Total	17,693,722	50,000,120	53,103,991	150,064,859

*SOURCE: 1970 Census of Housing
+Assumed average occupancy per housing unit = 3.0.

Table 20

Housing Units and Population Served by Sewers and On-lot Sewage Disposal Systems Inside and Outside SMSAs*

	Housing Units Served		Population Served+	
Sewage Disposal	Inside SMSAs	Outside SMSAs	Inside SMSAs	Outside SMSAs
Public Sewer	37,833,694	10,353,981	113,549,888	31,075,300
Septic Tank or Cesspool	7,693,047	8,908,745	23,089,065	26,737,727
Other	551,900	2,352,475	1,656,412	7,060,460
Total	46,078,641	21,615,201	138,295,364	64,873,487

*SOURCE: 1970 Census of Housing
+Assumed average occupancy per housing unit = 3.0.

In a septic tank system, raw sewage decomposes anaerobically before being applied to a subsurface disposal bed for infiltration into the soil. Standards for installation have varied widely--in rural areas, local rules of thumb have generally caused no problems in operations, as population densities are sufficiently low and lot sizes sufficiently high to permit generous margins for error. But problems did occur when these rules of thumb were applied to large subdivision projects, and septic tanks began to be installed on much smaller lots than before, with inadequate designs and components. In some communities, failure rates within three to four years of construction have been as high as one-third; overall failure rates nationwide have been put as high as fifty percent, or as low as ten percent.[8] These failures prompted the Federal Housing Administration to conduct a number of studies of septic tank and alternative on-site disposal methods, and encouraged many local health departments to mistrust the use of on-site disposal systems and emphasize the construction of conventional sewer systems to replace them.

No practical system of wastewater treatment and disposal seems to be without drawbacks, however, and regionalized sewage treatment is not the best solution for all areas. If on-site disposal can be made to work properly, it offers the following advantages:

- Avoidance of costs for municipal sewer systems;
- Avoidance of point source discharges to streams;
- Groundwater replenishment.

While conventional treatment plants often claim that they are "ninety percent efficient" in removing pollutants from wastewater, a figure that is an overestimate in many cases, it is indisputable that the remaining portion of the sewage pollutants reach receiving streams. Thus, a region of one million people using such a plant discharges into streams a sewage load equivalent to at least that of 100,000 persons.[10] And this may be an optimistic appraisal: many treatment plants do not achieve (and may not be designed to achieve) ninety percent efficiency--fifty percent may be typical.[11] Complete breakdowns of plants also occur regularly, and completely untreated sewage may be discharged.

This chapter will present various design and regulatory approaches that can be implemented on the local level to improve the performance of on-site disposal systems, either presently existing or about to be installed. While EPA does not advocate the use of septic tanks as inherently superior to conventional sewage systems, it is highly important that localities act to optimize the performance of this important and environmentally sound method of wastewater management.

The Conventional Septic Tank System

A septic tank consists of a single chamber, usually of concrete, into which all household wastewater flows. A typical tank is shown in

Figure 3. Its length should be at least twice its width; it should have an effective depth of at least four feet; and it should be large enough to permit one or two days retention of liquids before discharging them into the soil.[12]

Solids in the influent are broken down and digested by anaerobic bacteria (bacteria which live in the absence of oxygen) in the tank. The bulk of solids are reduced in volume, and settle to the bottom as a layer of concentrated sludge. Greases and foam rise to the top of the tank, where they should be allowed at least eight inches of freeboard.[13] A typical septic tank removes all the incoming grit and produces an effluent with the following quantities:[14]

- Biological oxygen demand: 100-120 mg/l
- Suspended Solids: 50-75 mg/l
- Grease: 10-20 mg/l

Sludge that accumulates on the bottom of the tank rises over time, reducing the detention time of liquids in the system, and reducing the overall level of performance of the system. If the level of sewage or scum rises too high, they will be discharged directly into the seepage field and clog it entirely, backing up the system and possibly ruining the field permanently. Sludges must, therefore, be pumped out routinely, usually about every three to four years. Partial anaerobic digestion produces noxious sludge referred to as septage; this must be disposed of after pumping, usually by introducing it into conventional treatment plants (in which case it contributes to stream pollution) or by landfilling it. Approximately four billing gallons (fifteen million m^3) of septage must be disposed of each year.[15]

The disposal field consists of perforated pipes laid in gravel filled trenches (see Figures 4 and 5). The size of the field depends on the volume of effluent to be disposed of, the permeability of the soil and other factors. Typical field sizes range from 200 square feet for sandy-loamy soils to 1,600 square feet for some tightly packed soils.

The remaining contamination of the effluent is filtered out by soil particles and digested by aerobic bacteria (bacteria living in the presence of oxygen) in the soil itself. Disposal pipes should be kept within twenty-four inches of the ground surface since this is where most aerobic bacteria are concentrated.[16] The level of treatment given the wastes is extremely high in a properly operating system, equivalent at least to what is generally called advanced treatment. The purified wastewater ultimately returns to the groundwater formations below the seepage fields, where it may be recycled and reused.

Groundwater Contamination

The most important potential environmental problem associated with septic tank installations is contamination of groundwater supplies. The problem is typically most acute in areas where individual wells are

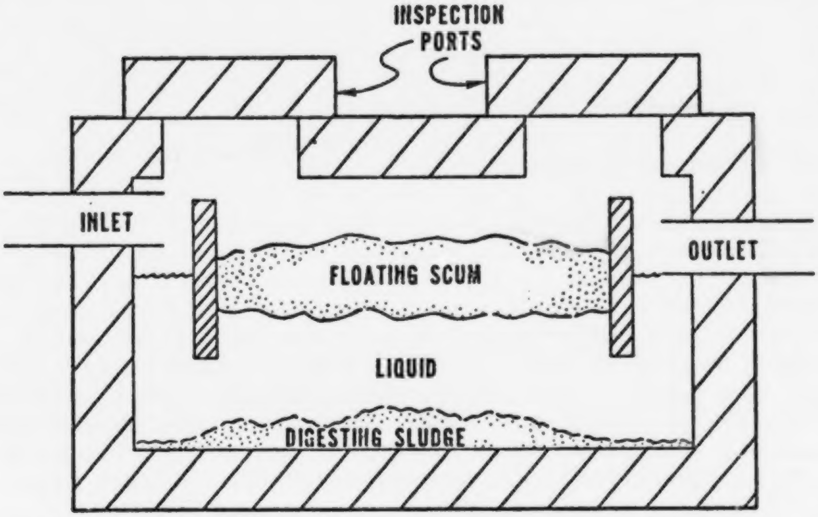

INSPECTION PORTS
INLET
OUTLET
FLOATING SCUM
LIQUID
DIGESTING SLUDGE

Figure 3

Septic Tank Schematic

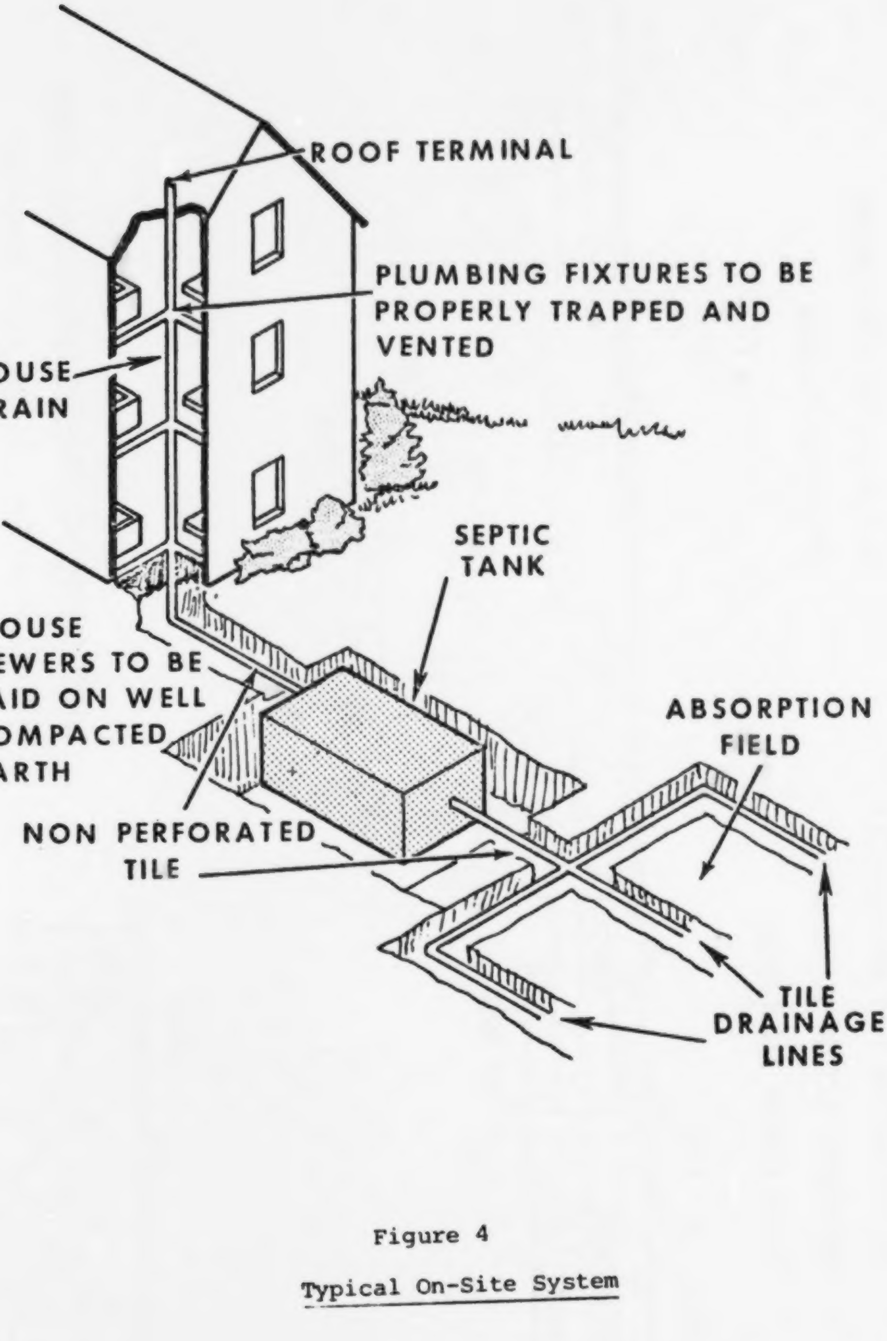
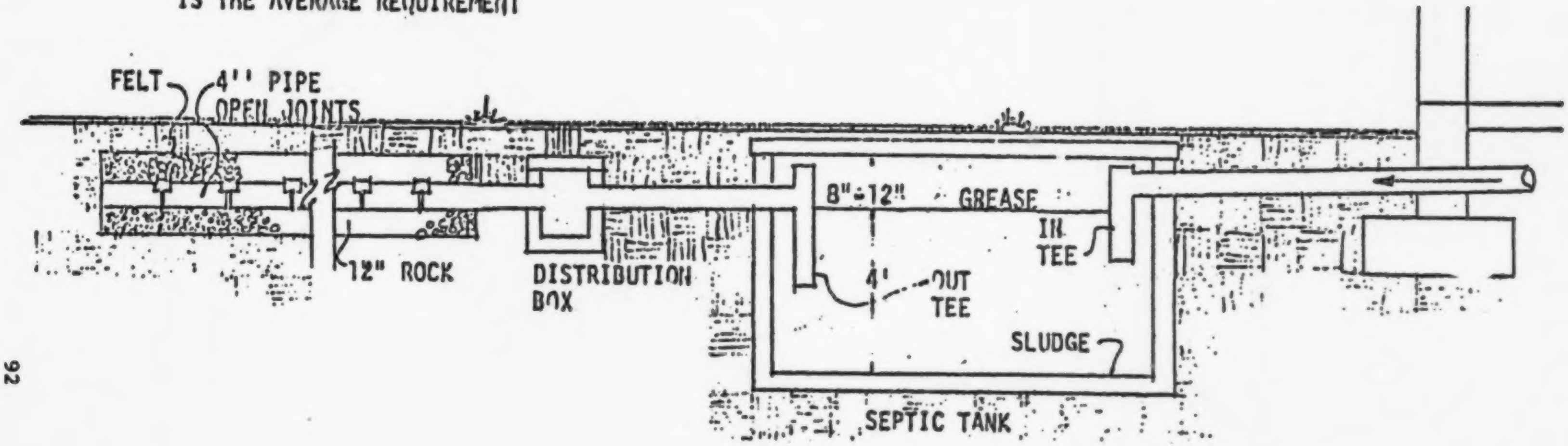

ROOF TERMINAL
PLUMBING FIXTURES TO BE PROPERLY TRAPPED AND VENTED
HOUSE DRAIN
SEPTIC TANK
HOUSE SEWERS TO BE LAID ON WELL COMPACTED EARTH
ABSORPTION FIELD
NON PERFORATED TILE
TILE DRAINAGE LINES

Figure 4

Typical On-Site System

DRAINFIELD SQUARE FOOT AREA
VARIES WITH NUMBER OF BEDROOMS
AND PERCOLATION TEST APPROXIMATELY
200 SQUARE FEET OF BOTTOM AREA
IS THE AVERAGE REQUIREMENT

TANK------CONCRETE
LENGTH----TWO WIDTHS
DEPTH-----FOUR FEET MINIMUM
750 GALLONS MINIMUM


FELT
4'' PIPE
OPEN JOINTS
12" ROCK
DISTRIBUTION BOX
8"-12"
GREASE
IN TEE
4'
OUT TEE
SLUDGE
SEPTIC TANK

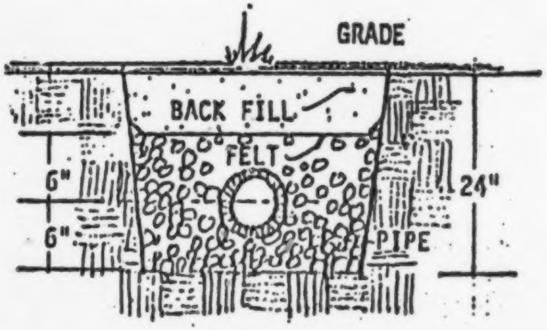

GRADE
BACK FILL
FELT
6"
6"
24"
PIPE

Figure 5

Layout and Specifications of Typical Trench System

SOURCE: Hancor Inc., On-Site Waste Management the source of domestic water. Between 1961 and 1970, 128 known outbreaks of waterborne disease were attributed to contaminated drinking water,and ninety-four percent of these outbreaks were linked to private water supplies.[17] Where seasonal high water tables rise close to the bottoms of disposal fields, where soils are shallow or of very high permeability, or where wells are located too close to seepage areas (generally, less than 75 feet), contamination of drinking water by pathogens contained in wastewater can be a problem. While this contamination is often difficult to document, it is the most commonly claimed reason for the replacement of on-site disposal by conventional sewer systems.[18]

A septic tank and leaching field system can remove pathogenic contamination before it reaches the groundwater by a combination of oxidation, filtration, and many other processes. Essential to this action is a combination of adequate soil depth and proper soil type.[19] An improperly sited leaching field is often the cause of groundwater contamination. States very considerably in the minimum depth to groundwater they require below the bottom of the leaching field. Some permit as little as eighteen inches of soil between the leaching field and the maximum groundwater level, others require considerably more. Where the groundwater is used as drinking water, the Soil Conservation Service recommends that at least four feet of soil be available between the bottom of the trenches or seepage bed and the water table or impervious rock formations. In addition, minimum distances between leaching fields and wells, streams, and lakes are often established to protect these sources of drinking water, but all such protective standards are useless if the soil on a particular site is inappropriate for septic tank use.

It is in the soil that the nutrients remaining in the septic tank effluent are consumed and the remaining particles and micro-organisms filtered out. If the soil is too porous, the contaminated effluent can flow directly into the groundwater, even if the minimum distances between leaching field and maximum height of groundwater are observed.

Improper construction practices may also contribute to system failure: the use of mechanical excavating equipment in building leaching fields may smear the soil surface and cut down its infiltration capability.[20] Most often, hosever, fields failed either through general "aging," by being clogged with particles or with an accumulation of anaerobically produced ferrous sulfate precipitate, or because of inadequate septic tank maintenance, which allows scoured sludge, scum, and unsettled, undecomposed sewage to flow directly into the field.

Septic tank systems are, at best, not very effective at removing nitrogen and phosphates: soils have a varying capacity for phosphorus removal, and few can hold nitrogen in the form of ammonia. In a malfunctioning system these chemicals can pose direct health hazards (e.g., nitrates are known to cause infant methemoglobinemia), or can serve as undesired nutrients affecting both groundwater and surface water supplies.

Surface Water Contamination and Runoff

Contamination of groundwater is not observable directly, but surface eruptions of septic tank effluent definitely can be. Effluent can back up, can cause ponding on flat areas, or can runoff and cause contamination of streams or lakes. Diseases may be transmitted through direct contact (especially where children and animals have access to contaminated areas) or through contamination of drinking water taken from nearby lakes or streams. Aside from such health problems, backed up systems cause unpleasant odors and other aesthetic nuisances.

There are many reasons for leaching field clogging and system back up. Heavy rains may saturate the soil, or a household may begin to generate more wastewater than the system can handle (particularly when a house is occupied by more people or appliances than it was designed for).

Other Impacts of Septic Tank Use

In addition to the direct environmental impacts of septic tanks on surface water and groundwater, the use of this type of on-site disposal involves indirect impacts on communities.

Land Use Effects: Because septic tanks require both the proper type of soil and an adequate field size, they have a significant effect on local land use. One study estimated that over sixty-eight percent of the United States is unsuitable for conventional septic tank installation because of soil problems.[21] In addition, the minimum lot sizes necessary for proper installations--usually at least one half acre--has in itself important implications for land use within communities. Such lot sizes are not usually compatible with some of the social objectives in planning suburban communities--especially the provision of low and moderate income housing. This latter is a large issue unto itself, but it is inappropriate to treat it here.

Several environmental issues are raised in connection with the land requirements of conventional on-site wastewater disposal. In particular, one must ask if a dispersed, low density development pattern is consistent with

- Management of non-point source water pollution and stormwater runoff.
- Air quality planning objectives.
- Transportation planning systems objectives.
- Energy efficiency (building, transportation, and discretionary uses).
- Community service provision (solid waste collection, police protection, schools.

Some of these issues are addressed in Section I. There are no ready answers to the problem of coordinating multiple environmental objectives of the local level, but readers should turn to Section VIII, Local Environmental Reviews, for a discussion of one effective and relatively straightforward approach.

IMPROVEMENTS IN ON-SITE WASTE MANAGEMENT SYSTEMS

Design and installation practices for septic tanks have improved over the years, but improvements are still needed. A few communities have extensive and well thought out regulatory policies regarding on-site disposal; others rely entirely on highly variable state policies. A recent study by Plews,[22] which contained data from thirty-seven states, showed that local departments generally have responsibility for on-site sewage regualtions. Of the states responding, fifteen leave control entirely up to localities, fifteen share the responsibility between localities and the states, six states assume full control over regulations, and one (Idaho) has a system of regional regulation which the study found to be a superior mechanism. Tables 21 and 22 summarize the design and installation requirements of the responding states.

There is room, therefore, for considerable improvement in local standards. This section presents some recent thinking on suitable improvements for on-site disposal practice. Most of the ideas are not new, but few are widely implemented. There is need for these ideas to be more widely disseminated, and source references are provided at the end of the chapter to supplement this overview.

The emphasis here is on technological and design improvements and associated implementation problems. On-site disposal practices have traditionally been set purely for public health protection, but today other issues, such as consumer protection and environmental control, are also being considered. And, the use of on-site disposal has a heavy political connotation that is beyond the scope of this report: in many rural areas, septic tank permits are the only control available for new construction; in suburban areas, the lot size requirements of septic tanks may serve as a de facto exclusionary growth control device, or, conversely, they may be granted to politically desirable subdivisions even though the housing sites are actually unsuitable for this type of wastewater management. This section presents methods for optimizing on-site disposal from the environmental and public health points of view only.

Design and Maintenance

Design: There are a number of sources that cover the design and construction of conventional systems using septic tanks. The U.S. Public Health Service Publication, Manual of Septic Tank Practices (Department of Health, Education and Welfare, Publication No. 526 (Rev., 1967), is the most widely used text on the subject, and is having an increasing effect on state and local standards nationwide.

Improved Percolation Testing: Unquestionably, the most important variable in the successful design of a conventional system is the disposal

Table 21

Septic Tank Design and Water Depth Requirements In Various States

States	Tank Size in Gallons					Minimum Water Depth (Feet)	Open Discharge
	Number of Bedrooms						
	1	2	3	4	5		
Alabama	1000	1000	1000	1200	1400	4	
Alaska	750	750	900	1000	1250	4	No
Arizona	960	960	960	1200	1500	4	No
Arkansas							
California							
Colorado	750	750	900	1000	1250	No Minimum	Yes
Connecticut	1000	1000	1000	1250	1500	1.5	No
Delaware							
Florida	750	750	900	1000	1200	1.5	No
Georgia	750	750	900	1000	1250	No Minimum	No
Hawaii							
Idaho	750	750	900	1000	1250	4	No
Illinois							
Indiana	750	750	900	1100	1250		No
Iowa	750	750	1000	1250	1500	1.5[A.]	Yes
Kansas							
Kentucky	750	750	900	1000	1250		No
Louisiana	500	750	900	1150	1400	None	Yes
Maine	750	750	900	1000	1250	2	Yes
Maryland							
Massachusetts							
Michigan							
Minnesota							
Mississippi							
Missouri							
Montana	750	750	900	1000	1250	4	No
Nebraska[B.]	750	750	900	1000	1250		No
Nevada	1000	1000	1000	1000	1250	4	No
New Hampshire	750	750	900	1000	1250	4[A.]	No
New Jersey							
New Mexico							
New York							
North Carolina	750	750	900	1000	1250	2[A.]	No
North Dakota							
Ohio	1000	1000	1500	2000	2000	4[A.]	Yes
Oklahoma							
Oregon	750	750	900	1000	1250	1.5[A.]	No
Pennsylvania	900	900	900	1000	1100	4	No
Rhode Island	750	750	900	1000	1250	3	No
South Carolina							
South Dakota	1000	1000	1000	1250	1500	4	No
Tennessee	750	750	900	1000	1250	4[A.]	No
Texas							
Utah	750	750	900	1000	1250	1	No
Vermont							
Virginia	30 hour	Detention	100 Gallons Per Day			No Minimum	Yes
Washington	750	750	900	1000	1250	3[A.]	No
West Virginia	750	750	900	1000	1250	4	No
Wisconsin	750	750	975	1200	1375	3[A.]	No
Wyoming	750	750	900	1000	1250	4	Yes

SOURCE: Plews, "The Adequacy and Uniformity of Regulations for Onsite Wastewater Disposal - A State Viewpoint."

Table 22

Absorption Field Design Requirements In Various States

State	Setbacks		Minimum Spacing (Feet)	Minimum Cover (Inches)	Minimum Percolation Restrictions	Trench Widths (Inches)	Sizing
	Well	Surface Water					
Alabama	50—75		6	6	None	18—36	Perc
Alaska	50—100	50—100	6	12	None	12—36	Perc & Soils
Arizona	50—100	100	6	12	None	12—18	Perc
Arkansas	- - -	- - -	- - -	- - -	- - -	- - -	- - -
California	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Colorado	100	50	6	12	None	18—36	Perc
Connecticut	75	50	6—9	6	None	18—36	Perc
Delaware	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Florida	75—100	50	6—8	12	None	18—24	Perc & Soils
Georgia	100	50	10	12	None	18—36	Perc & Soils
Hawaii	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Idaho	100	100—300	6	12	None	12—36	Perc & Soils
Illinois	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Indiana	50—100	50	6—7.5	12	None	18—36	Perc
Iowa	100—200	25	7.5	12	None	18	Perc
Kansas	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Kentucky				None			Perc
Louisiana	100			6—12	None	12—18	Perc
Maine	100—300	50—100	10	2—6	None	24	Soils
Maryland	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Massachusetts	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Michigan	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Minnesota	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Mississippi	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Missouri	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Montana	100	100	6	12	Yes	12—36	Perc & Soils
Nebraska[B.]	100	50	6	6	No	18—36	Perc
Nevada	100	100	6	4—6	Yes	12—24	Perc
New Hampshire	75	75	6—7.5	6	None	12—36	Perc
New Jersey	- - -	- - -	- - -	- - -	- - -	- - -	- - -
New Mexico	- - -	- - -	- - -	- - -	- - -	- - -	- - -
New York	- - -	- - -	- - -	- - -	- - -	- - -	- - -
North Carolina	- - -	- - -	- - -	- - -	- - -	- - -	- - -
North Dakota	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Ohio	50		6	6	None	8—30	Soils
Oklahoma	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Oregon	50—100	50—100	10	6	None	24	Soils
Pennsylvania	100	50	6	12	Yes	12—36	Perc
Rhode Island	100	50	6	12	None	18	Perc
South Carolina	- - -	- - -	- - -	- - -	- - -	- - -	- - -
South Dakota	100	100	6		Yes		Perc
Tennessee	50	50	6	12	None	18—36	Perc & Soils
Texas	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Utah	100	100	6—7.5	12	None	12—36	Perc
Vermont	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Virginia	35—100	50—100	6—9	None	None	18—36	Perc & Soils
Washington	75—100	100	6	6	Yes	18—36	Perc & Soils
West Virginia	100	100	6	12	None	12—36	Perc
Wisconsin	50—100	50	10	12	None	18—36	Perc & Soils
Wyoming	100	50	6—7.5	6—12	None	12—36	Perc

SOURCE: Plews, "The Adequacy and Uniformity of Regulations for Outside Wastewater Disposal - A State Viewpoint."

field. Most often, this is done on the basis of percolation tests in the field to determine the rate of infiltration of water into the soil. Although the reliability of this test has been challenged, the percolation test is an adequate way to evaluate soils for their suitability of wastewater disposal if properly conducted.[23] While more sophisticated tests are often desirable, the percolation test remains the basis of disposal field design in the majority of communities.

Presently, there is no standard method used nationwide by which percolation tests are conducted.[24] In concept, a percolation test involves drilling a hole in the ground, filling it with water, and seeing how long it takes the water to soak in. According to Winneberger, "most fieldmen commonly perform what they believe to be percolation tests, but in reality they only measure their ability to destroy soils."[25] To illustrate the inconsistency of results of such testing, Winneberger had three firms perform tests at nine locations, making test borings to farther than two feet apart. The results of these tests are illustrated in Table 23 and show virtually no uniformity at all.

Percolation tests, to be done properly, must allow for soil saturation and swelling, and must reach a point of relative equilibrium or constant rate of drop, in order to provide a sound basis for determining the absorptive capacity of a soil.[26] A recommended procedure for soil percolation tests has been developed by Winneberger, and is presented below.

Tank Sizing: According to analysis in the 1950's, when large-scale suburban subdivisions were being built all across the country, builders were already accepting the need for larger septic tank units to meet the increased water use of houses with (then unusual) water-using appliances such as dishwashers, garbage grinders, and home washers.[27] These appliances are much more widespread today than they were then. Between this increased water use and the tendency for maintenance to be postponed (thus reducing the net available tank size because of sludge build-up), oversizing of septic tanks is a good safety factor as a hedge against possible field clogging. Some have suggested that the use of garbage grinders be prohibited in areas with septic tanks, since they contribute a high volume of organic wastes to tanks and pose an increased threat of sludge buildup. The impact of dishwashers and garbage grinders on water use itself, and thus on field sizing, is minimal. Figures 6 and 7[28] show daily water use and chemical oxygen demand for a typical household.

Overflow Warning Devices: The most common source of failure of a septic tank system is destruction of the absorption field due to lack of maintenance of the tank. As recounted above, sludge builds up, ultimately flowing directly out into the field as solid matter and clogging the soil particles. In order to signal the necessity for maintenance before the field itself is destroyed, the use of an inverted cone sludge deflector suspended two inches below the outlet tee of the tank has been suggested:[29] rising sludge will raise the cone and block the outlet, causing a backup of sewage into the household--a warning that cannot be ignored but which does not jeopardize the functioning of the field nor cause as much damage as the destruction of the field.

Table 23

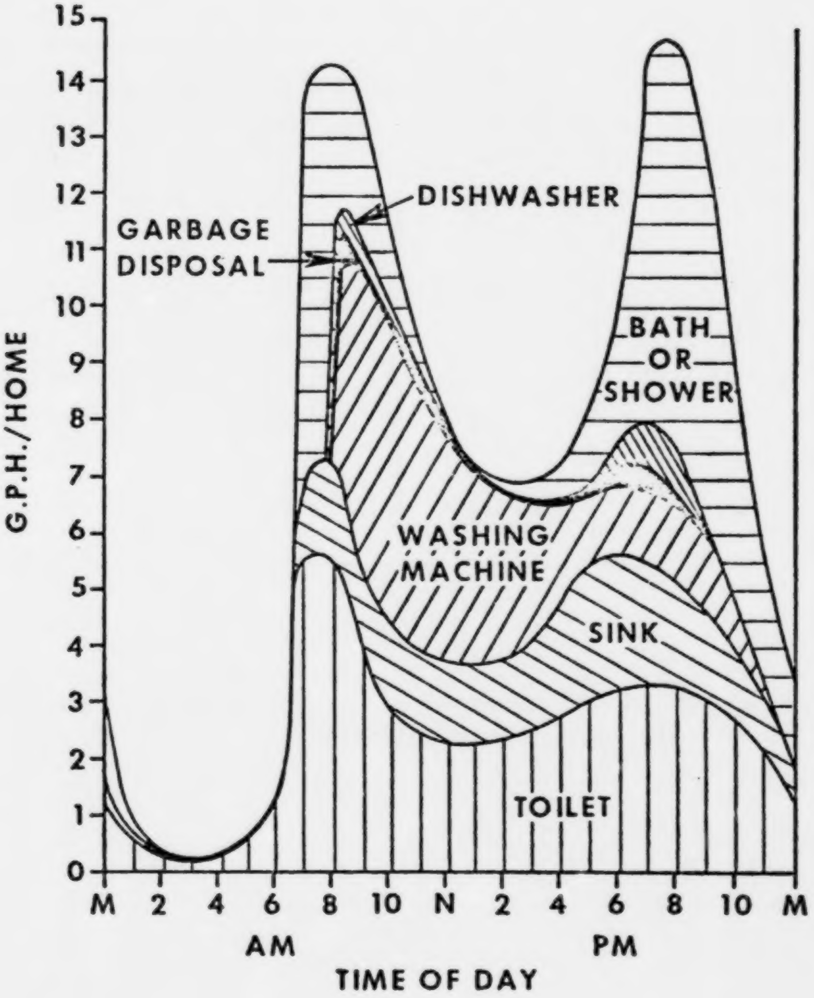
Replicate Percolation Tests Performed for Three Soil Firms

Location	Ultimate Percolation Rate, min./in.		
	Firm No. 1	Firm No. 2	Firm No. 3
A	23	118	37
B	15	59	172
C	2	15	32
D	130	91	161
E	5	59	73
F	2	12	24
G	3	39	229
H	4	22	34
I	19	63	259

SOURCE: Winneberger, "Correlation of Three Techniques for Determining Soil Permeability."

Figure 6

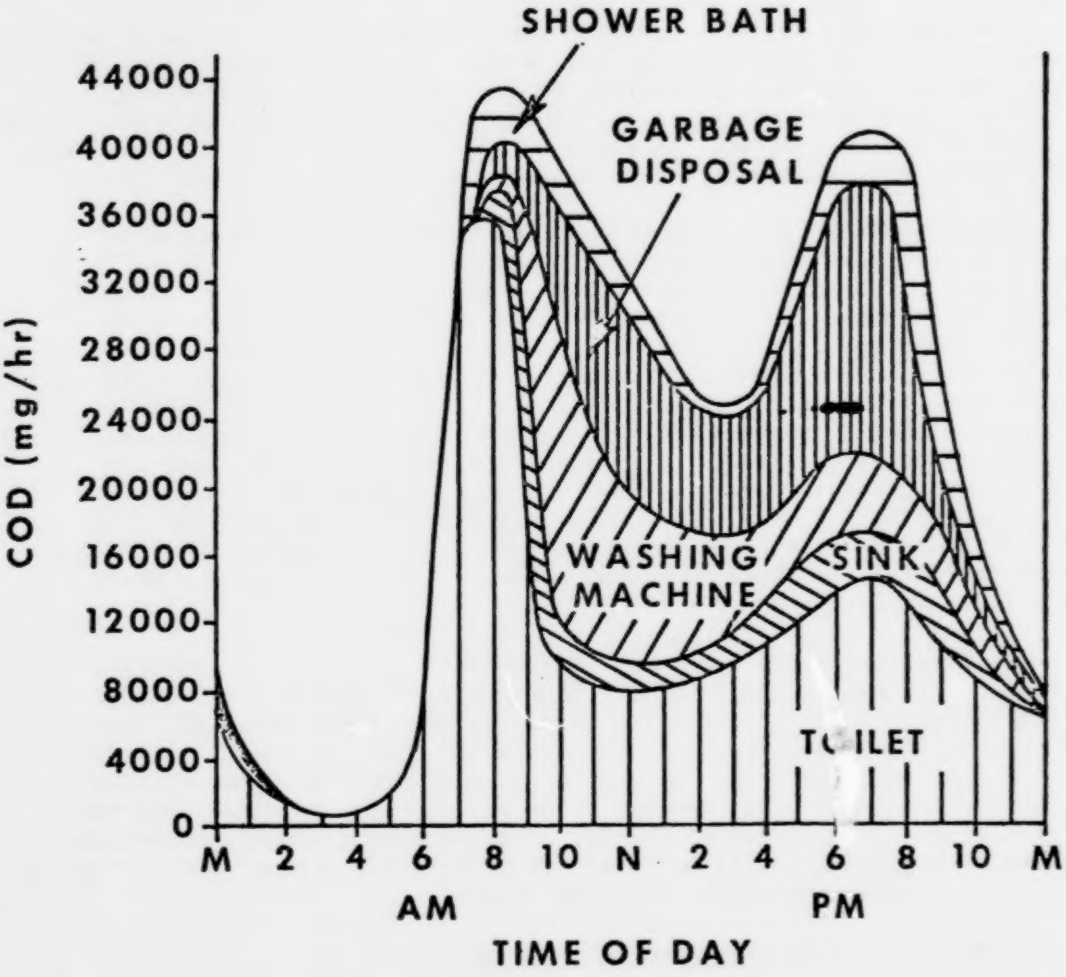
Daily Household Water Use



SOURCE: Kreissl, "Rural Wastewater Research."

Figure 7

COD Profile



SOURCE: Kreissl, "Rural Wastewater Research."

Maintenance of septic tank systems is notoriously poor. Checking the level of solids in a septic tank is an unpleasant and difficult task, and it is understandable that even conscientious owners are likely to postpone doing it until trouble erupts in the backyard. Maintenance ports on most septic tanks are buried between twleve and eighteen inches below the surface of the ground: the earth above must be removed, the top opened, and a measuring stick of some sort must be introduced to gauge the level of the solids and scum. When maintenance is postponed, it is easy to forget the location of the tank, and if properties are transferred to new owners, even a general idea of the tank location may be lost. Drawings should be kept locating the maintenance port in relation to fixed features on the lot, and if possible a permanent market installed above the port (flush with the ground if located on a lawn that must be mowed). If a seal is provided to keep odors from escaping, maintenance ports can themselves be placed on grade.

A low visibility issue, one that should be explicitly addressed by communities implementing comprehensive programs to improve on-site disposal, is the fate of sludges pumped from septic tanks. Open dumping of sludges is generally prohibited near population centers, thoguh in more remote areas this highly undesirable practice may slip by. More common practice is to introduce these wastes into nearby municipal treatment plants, or to landfill them. The former is acceptable, but any comprehensive program for continued reliance on septic tanks in a community should be accompanied by effective facility planning of municipal plants, such that sufficient capacity is continuously available for the routine disposal of septic tank sludges. The extent of the disposal problem is major, as some four billion gallons of septage are generated each year.[30] Some communities are building centralized septage treatment plants, with federal grants under the Water Pollution Control Act.

Acceptable techniques for landfill of septage are somewhat different from those pertinent to the landfill of municipal treatment plant sludge. Although sludges can be suitable for landfill, (provided industrial toxics are not present) septage is generally harder and more unpleasant to work with, and its effects on soils are not as well understood as the effects of secondary treatment plant sludge. Some states, such as Maine, are now requiring lime stabilization of septage prior to land disposal, increasing its pH to as high as 11 or 12 in an effort to kill off some of its pathogenic organisms, and to make handling less unpleasant.

Extending the Life of On-Site Disposal Systems

Septic tank installations are often considered a stop-gap measure prior to the development of municipal sewage treatment systems. Average life-times for disposal fields are usually quoted as about fifteen years, but some recent studies suggest that with proper design the fields may last a good deal longer--perhaps indefinitely. While the data is not yet sufficient to prove this claim, it does appear that the much maligned septic tank system can yield effective service to a community, and postpone (or conceivably avoid) the need to go to conventional end-of-the-pipe solutions to wastewater disposal.

In 1956, Fairfax County, Virginia, passed a new septic tank ordinance that made use of accurate soils surveys to establish criteria for new installations. This has been updated from time to time, and remains one of the most comprehensive such ordinances now in effect. The ordinance calls for a soil evaluation of the drainage field including,

> "...consideration of physiographic province, position of landscape, degree of slope and soil profile (thickness of horizon, color, texture). Such evaluations shall indicate whether or not the soil has problems relative to the position in the landscape, seasonal water table, shallow depths, rate of absorption, or a combination of any of the above. If absorption rate problems are suspected and there is no indication of a water table, *percolation tests should be made but their results shall not be presumptive, prima facia or conclusive evidence as to the suitability for effluent absorption*. Such percolation tests may be considered and analyzed as one of many criteria in determining soil suitability for absorption of effluent."[31]
>
> (emphasis added)

The effect of this ordinance on actual performance of individual systems has been beneficial. A study done by the County Health Department in 1973 revealed that "septic tank systems, properly designed and installed under fairly good controlled conditions, were surviving, not an average life of fifteen to twenty years as the department expected on the basis of literature and field experiment, but more like twenty to thirty years. It is true that of those that did fail, the average life span was about ten to fifteen years, which had led officials to underestimate the life span of all septic tank systems."[32] For instance, of the 230 systems installed in 1952, ninety-four percent were still functioning in 1971; and of the approximately 1,500 systems installed since 1966, not one had failed by 1971.[33] It is clear from evidence such as this that septic tank systems are capable of giving prolonged service; as a consequence of this survival data, the county dropped requirements for mandatory connections to new sewer systems within five years of the installation of those systems, except in the case of failure of the on-site system.

In 1973, further modifications to the septic tank ordinance were passed, modifying some previous practices and adding a significant technical innovation--split field absorption systems.[34] The points of departure were:

(1) to permit installation of drainfield laterals on six-foot centers rather than eight-foot centers. (to conserve absorption area);

(2) to require installation of all future absorption systems in two separate sections with separate distribution boxes and a flow diversion valve or some other satisfactory method for utilizing half of the total system for a period of time, then switching to the other for a similar period;

(3) to require an area to be reserved for possible future expansion of the absorption system equal to fifty percent of the area required by the initial installation.

Combined with controls over the installation of all new systems and requirements for mandatory maintenance, regular cleanings, and regular alteration of drainage fields, the county expects that new systems will function properly for "30 to 50 years or even indefinitely."[35]

Improved Maintenance

Lack of maintenance is the most often cited reason for septic tank failures. Accumulating sediment in the tank finally reaches to the level of the outlet and flows into the disposal field, blocking the soil and backing up the entire system. Once this happens, the field may be permanently ruined--i.e., it would require excavation and relaying of the pipe in order to restore adequate infiltration of liquids into the soil.

Various communities have experimented with making septic tank maintenance services available from the town for a small fee. (See Appendix IV-1.) There is no legal impediment, however, to requiring maintenance as a condition of operating a septic tank. This chapter presents the necessary legal language to set up such a system below. Maintenance requirements would include at least biannual inspections of the levels of solids in tanks, and compulsory pumping of septage if the levels are excessively high. Inspecting a septic tank is a time consuming and unpleasant task that should be made mandatory if it is to be conscientiously done across the entire community.

Alternating Disposal Fields

The purpose of alternating disposal fields is to permit each half of the total field to rest and regain its absorptive capacity. When flow to one half of the field is cut off, its soil increases its rate of aerobic decomposition, and biochemically degrades clogging materials into liquids and gases. The soil near the trenches also dries out and cracks, improving the soil's texture and its infiltrative capacity.[36] It is recommended that alternating between fields be done annually. In order to aid implementation of this innovative approach, the pertinent sections of Fairfax County's Ordinance are included in the Section entitled, "Improvements in On-Site Management Systems," with minor revisions.

Design of systems to permit field alternation is simple. First, fields must be laid out with an even number of trenches. While this may be difficult on certain small lots, it should not be an obstacle if properties have been adequately zoned for the installation of on-site disposal systems. Second, some means of diverting the flow from one half of the field to the other must be provided: various valves are available for this purpose.

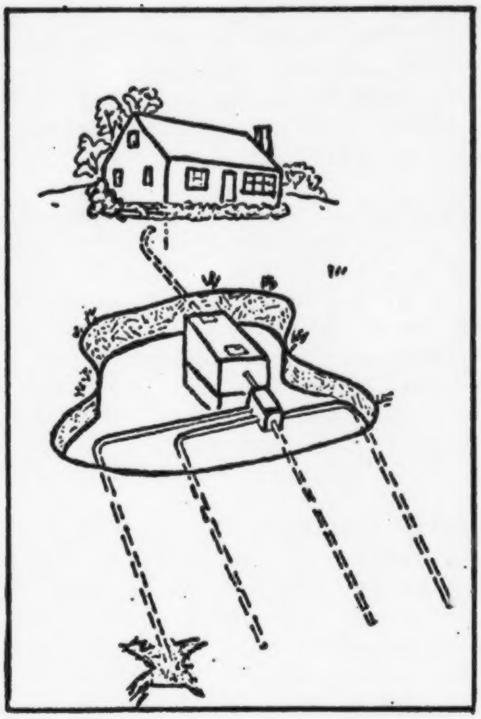
Actual layout of the alternating trenches can be done in a variety of ways. Total size of the installation apparently need not be larger than the size of a single field. Winneberger recommended that trenches be laid out in an interlaced fashion, with every other trench connected to one-half of the distribution box.[37] This tends to optimize sub-irrigation of vegegation, especially trees: with separate alternate fields, trees in one-half of the system would be deprived of irrigation every other year; interlacing the fields allows for a constant level of subirrigation and maximization of evapotranspiration from the field.

At present, two companies in the United States offer a proprietary device that performs the necessary function, though the requirements are so simple that no valve is actually needed. The simplest version of the idea would involve construction of a diversion box, with the septic tank output pipe on one side and the two field outlets on the other. Use of the system would simply require plugging one of the output pipes with a tennis ball or other closure. The box could be opened yearly and the tennis ball moved to the opposite pipe. For the average homeowner, this device has obvious aesthetic defects, especially if he has allowed one of the field halves to back up and is faced with a general overflow.

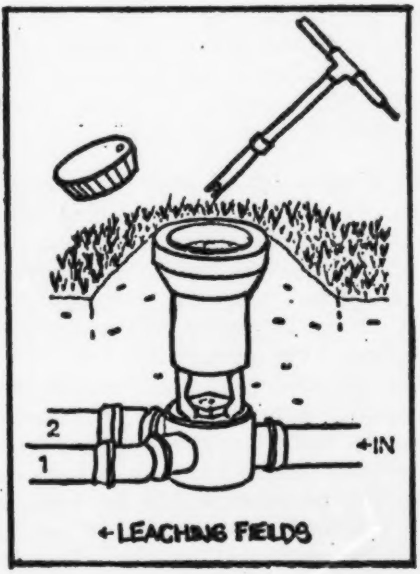
One of the commercially available valves, made by Hancor Corporation in Ohio, is housed in a plastic box below ground. While it works well for all ordinary situations, the homeowner would still be faced with an unpleasant problem if an overflow occurred. The other valve, made by Franklin Research in California, is operated from above ground level by the use of a long key (see Figure 8). Diverting the flow between fields is thus physically easier, and in the event of an overflow no part of the valve system need actually be touched by the owner--control is from above ground. The latter valve, with its increased consumer acceptability, is the one used in Fairfax County, Virginia. While not identifying it by brand name, the specifications set out in Section 22-44.1 of the ordinance identify it for all practical purposes. Part (b) of the same section permits any equivalent system to be used, provided it is approved by the Health Director. Virtually all installations in Fairfax County actually use the Franklin Research valve; the cost for the valve and its installation kit is about $100, a modest additional cost for hew houses.

Once the use of split fields is adopted in a municipality's sewerage system code, successful use of the systems must be assured: the valve must be switched annually. Fairfax County uses a mailed reminder: every year postcards are mailed out to all owners using the system, asking them to switch their valve, check off that they have done it, and mail back the card. If no response is received after a reasonable length of time, the town sends out someone to turn the valve. The procedure is less than two years old, and it is not known if this approach will be successful. A more conservative, though certainly more expensive approach, is to have all valves turned by town personnel. This could be done whenever water meters are read,[38] for instance, though the cost would definitely be greater. Homeowners would have to pay the costs, but the process would be more reliable over the long run. Site visits would be charged automatically on an annual basis. Location of the valve could be recorded on the city records--along with the location of the septic tank maintenance port, if the maintenance permit system is also used--minimizing on-site time.

Figure 8



a. Layout of a Field with an Even Number of Trenches



b. A Flow Diversion Valve with an External Regulatory Key

SOURCE: Clayton, J.W., An Analysis of Septic Tank Survival Data from 1932 to 1972 in Fairfax County, Virginia

Innovative Technologies

Various new technologies are being developed to handle small flows of wastewater. Three of these are discussed briefly here:

(1) Alternatives to the septic tank, including "waterless toilet" technologies which may potentially permit the use of smaller disposal fields for handling washing water ("graywater").

(2) The Mound System of on-site disposal, which allows the use of conventional septic tanks on lots otherwise not suitable for use because of inadequate soil infiltration characteristics.

(3) Pressure sewers, which allow low density development in areas of hilly terrain to be sewered at low cost and which allow relatively inexpensive connections to be made between existing sewers and lots on which septic tanks have failed.

Variations on the Septic Tank--

A number of variations on the conventional septic tank are marketed today,[39] using both anaerobic digestion (as does the septic tank), and aerobic digestion. Advantages quoted for the various systems include higher effluent quality, less stringent disposal field specifications, or both. A very brief description of some of these are presented here.

Anaerobic Systems: Improvements on the septic tank itself have been designed and are being tested. Multiple chambers are used, in which wastes are permitted longer digestion times and greater degrees of settlement are achieved. An experimental septic tank at the Sanitary Engineering Center at the University of California has been tested to yield fifty percent BOD removal, and seventy-three percent removal of suspended solids--better overall performance than is expected with conventional installations. A fiberglass tank system, marketed by the Armon Company,40 has also been tested: it uses separate inputs for sanitary and wash water wastes, thus isolating the more concentrated wastes from the harmful effects of detergents and cleaning solvents and giving them longer digestion time. Its performance may be slightly better than the experimental septic tank. The theoretical advantage of such improved anaerobic systems is in reduced requirements for disposal fields: although the tanks and their installation are slightly more expensive than conventional units, they are supposed to be used to advantage where local soils are of fair to poor quality. The Armon unit has been approved by the Federal Housing Administration, but good data on its actual performance under field conditions are not yet available.

Aerobic Systems: A variety of units are available for individual household installation that use aerobic digestion of wastes, much as a conventional secondary treatment plant does. Advantages of the system are claims of a generally higher quality of effluent (eighty percent suspended solids removal and ninety percent BOD reduction), and a consequent reduction in the size of the disposal field.[41] Operating costs are higher, since mechanical aerators are necessary, and the system is susceptible to disruptions (and consequent variations in effluent quality) due to shock loadings of concentrated wastes and harmful chemicals. Only a dozen or so companies now produce aerobic units, and only about 20,000 to 30,000 have been installed nationwide.[42] Costs of installation run from about $1,100 to $2,500 per unit, with annual operating costs (electricity, service, maintenance, and disinfection) of between $85 and $210. Because of these high costs, efforts have been made to find other means of economizing on installations, notably through allowing aerobic effluents to be discharged into surface drainage (storm sewers), rather than requiring subsurface disposal, as with septic tank effluent.

Under stable conditions, however, aerobic units may permit different criteria for seepage bed design. University of Wisconsin studies show the following:

parameter	aerobic	septic
BOD, mg/l	47	158
SS, mg/l	53	54
Fecal Coliform, no./ml	107	4,210

But, although some units do consistently produce effluent suitable for surface disposal, others do not,[43] and even the superior units are vulnerable to occasional upset which might indirectly lead to the discharge of dangerous pathogens into community waters. This danger and the administrative difficulties of system monitoring of individual discharge performance have made the use of aerobic units severely limited, at least for the present.

In-House Composting: Perhaps the most far-reaching innovation in the field of on-site disposal is the idea of separating waste components within households and disposing of them by separate technologies. One system receiving wide attention in environmental circles recently is the Swedish Clivus Multrum. Contained entirely within a building and having no moving parts, the Multrum functions as a toilet and garbage disposal. No water is used in its aerobic composting process, so all bathing and washing water must be treated separately.

The Multrum has received interest because its effluent, produced after about four years of continuous decomposition, is environmentally innocuous humus and full of nutrients useful for fertilizer.[44] It is designed to be odor-free (it vents through its own chimney), and to those accustomed to it, it provides the same amenities as conventional plumbing. The two issues associated with this and similar waterless household waste treatment technologies are:

(1) Consumer acceptance: "Black hole" toilets are not likely to be accepted by the existing housing market, and construction of the unit is presently suited to first or second floor installation only.

(2) "Graywater" disposal: Wastewater from sinks, washing machines, and other water using appliances must still be disposed of, either into sewers or on site.

The acceptability to consumers of systems like the Multrum may change over time. Iowa, Maine, Nebraska, New Hampshire and Oregon have approved the Multrum for general use, and in Vermont and Missouri approval is easily obtainable under state codes. In total, installations have been made in thirty-six states. Several research studies on the public health aspects of the system are being conducted by various groups in this country and Canada, though the National Swedish Board of Health and Welfare has studied and approved it already. The system's marketers hope that, once the system is widely accepted for general use by public health departments, increased installation will follow, even in conventional housing developments. At present, the Multrum is used mainly in rural areas, where water supplies are limited and sewers unavailable. Most of the installations to date in this country have been made by committed environmentalists, however, who cannot be represented as typical consumers. Whether the device will ultimately be accepted by the public remains to be seen.

The graywater disposal problem associated with Multrums and similar units cannot be minimized. While graywater is free of the heavy nutrients and contaminent loads associated with human wastes, it does contain most of the greases and phosphates (from detergents) which are present in combined sewage flows. In addition, the quality of graywater varies greatly between households: for instance, graywater from households with infants is likely to contain significant fecal wastes, possibly containing pathogens. Because technologies for the treatment of graywater simply have not been developed--there has been no need for it until recently--most health departments require that it be treated by conventional septic tanks and subsurface disposal, or else be discharged to sewers. Although septic tanks and fields can be smaller because of reduced waste loads and water flows, the expense involved in the installation of a dual system is likely to obviate the advantages of installing a Multrum in the first place.

If current research validates the claims of the Multrum's manufacturers that it is perfectly safe, local governments should, at the least take steps to permit its use under applicable building and plumbing codes. Advantages of the system to local communities include:

(1) An approximate one-third drop in household water use;

(2) a. Significant drops in waste loadings and flow volumes to local sewage treatment plants and reduction of point source discharges to local water bodies; or

  b. postponement or avoidance of conventional sewer and treatment plant construction and operating costs;

(3) Where on-site disposal is practiced, a greatly reduced hazard of groundwater contamination with either nitrates or human pathogenic organisms.

Mound System--

The use of on-site disposal is seriously hampered where seasonal high water tables and slowly permeable soils exist. The two often go hand-in-hand: in the spring and fall, infiltrating surface water may not be able to percolate through slowly permeable subsoil horizons, and may remain perched within a couple of feet of the surface. In such situations, the "mound systems" described below may be used to permit safe disposal of septic tank effluent, reducing the need to build more expensive conventional sewer systems.

The theory of the mound system is simple and direct: if the existing absorption field is inadequate, a new one can be built above it by importing a suitable fill material. A typical cross section of a mound is shown in Figure 9. There are various technical advantages to constructing a fresh field above the surface, rather than excavating below the surface; perhaps the most important is that smearing and compacting the soil beneath is avoided.[45] Wastes are filtered through a bed of sand laid on top of the existing soil, which in turn is covered with top soil and landscaped. While the system is not suitable for every site condition, it can be used many places where traditional septic tank installations would not be possible.

Because the level of the mound is raised above the grade, an electric pump is often needed to life wastewater several feet for dosing into the mound. This is an extra expense beyond the construction of the mound itself. Mounds rise three to four feet off the ground, and may be sixty-five feet on a side for a typical home[46]--they clearly pose consumer acceptance problems as a solution in conventional subdivision layouts, where they may occupy most of the available backyard space. Nevertheless, there is no reason why they cannot be landscaped attractively, making a virtue of a necessity. They have been accepted for installation in Wisconsin under conditions where soil percolation ranges between 60 and 120 min./in.[47] and where the seasonal water table reaches up to two feet below the surface. They may be an important alternative available to communities that wish to avoid having to build conventional sewer systems. Additional information on the concept is available through the references listed in the back of this chapter.

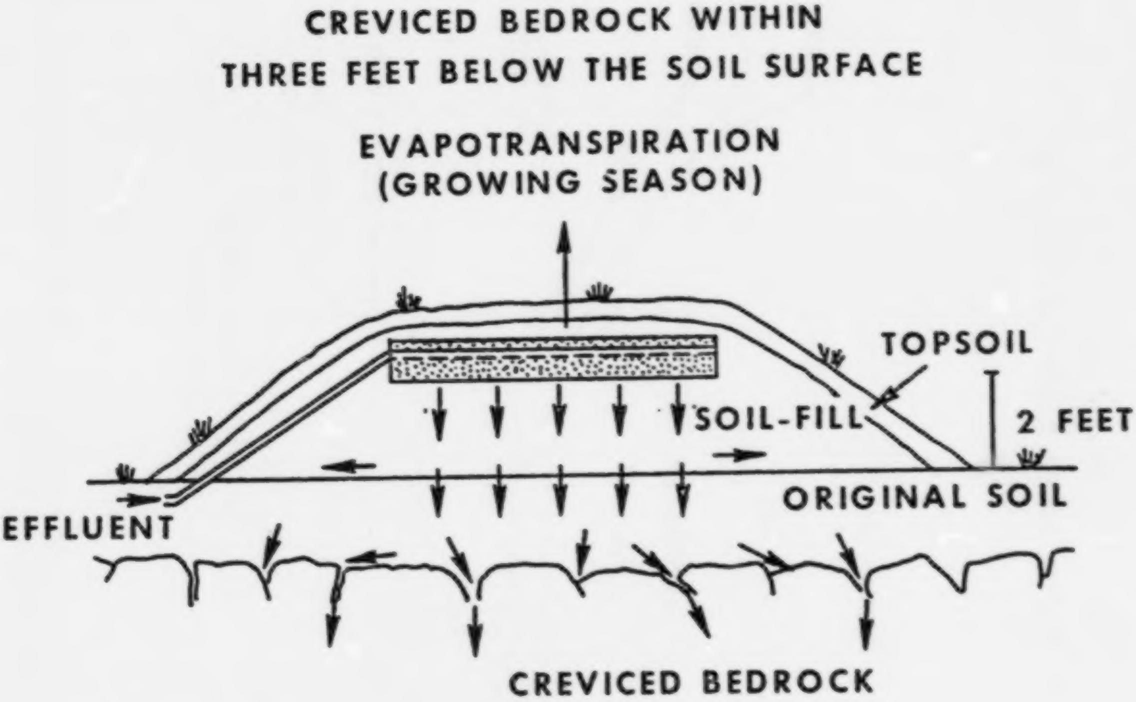
Pressure Sewers--

The Environmental Protection Agency has supported four experiments in the use of pressure sewers, at Grandview, Indiana; Phoenixville, Pennsylvania; Albany, New York; and Bend, Oregon.[48] These systems pump wastewater under pressure through shallow narrow gauge pipes, eliminating the need for laying deep gravity flow lines. They are expected to be most useful in areas where existing septic tank systems have failed and the terrain is unsuitable for the construction of conventional sewers, or where new development is desired in locations that either are very hilly or have high water tables, making conventional gravity systems prohibitively expensive.

The specifications of the Phoenixville system are as follows. (Figure 10 shows a schematic installation.) Lines of three-inch PVC pipe are laid

Figure 9

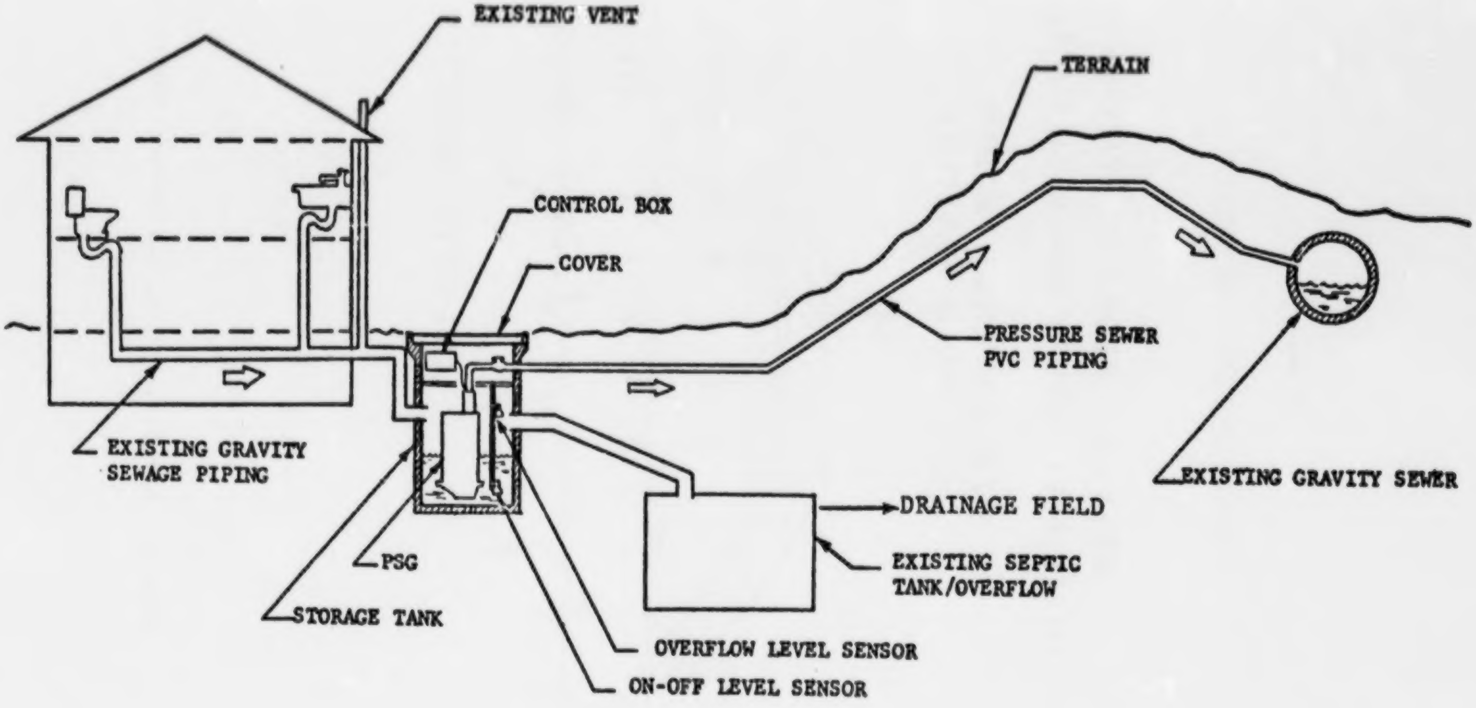
Mound Over Creviced Bedrock


CREVICED BEDROCK WITHIN
THREE FEET BELOW THE SOIL SURFACE
EVAPOTRANSPIRATION
(GROWING SEASON)
TOPSOIL
SOIL-FILL
2 FEET
ORIGINAL SOIL
EFFLUENT
CREVICED BEDROCK

SOURCE: Kreissl, "Rural Wastewater Research."

Figure 10

Typical Pressure Sewer Installation


EXISTING VENT
TERRAIN
CONTROL BOX
COVER
PRESSURE SEWER
PVC PIPING
EXISTING GRAVITY
SEWAGE PIPING
EXISTING GRAVITY SEWER
DRAINAGE FIELD
PSG
EXISTING SEPTIC
TANK/OVERFLOW
STORAGE TANK
OVERFLOW LEVEL SENSOR
ON-OFF LEVEL SENSOR

SOURCE: Mekosh and Rainos, Pressure Sewer Demonstration at the Borough Of Phoenixville, Pennsylvania.

thirty inches below the ground surface to escape freezing. They carry an average flow of eleven gallons per minute under up to fifty pounds of pressure per square inch. Sewage is ground up by pumper-grinders in each house before it is fed into the pipes. In the event of a system failure, standby septic tanks are available for overflow. In one case, a house served by the system was separated from the existing gravity sewer line by one-half mile lateral distance and sixty feet in elevation. The system involved no treatment of sewage whatever, operating in an anaerobic (septic) mode with zero oxygen levels.[49]

Costs for the system were as follows: The pressurized line was installed at a cost of $3.00 a linear foot, and operating costs averaged $.50 per month per unit served. The initial cost of installation of equipment (storage tank to handle peak flows, Pump Storage Grinders, mechanical and electrical connections) for each of five locations was $2,050. Since five houses and seven apartments were served, this averaged to $850 per unit.

The installation was deemed a success. Further information on this technology is available through the EPA. Pressure sewers may prove to be a valuable option to have available for special use as a safety option in areas where maximum reliance on conventional septic tanks is planned.

COSTS OF ON-SITE DISPOSAL

Conventional Septic Tanks

One of the greatest advantages of conventional septic tank systems is their low cost. Of all the standard methods of wastewater treatment currently popular, they are the cheapest.

The calculations in Table 24 are based on 1973 dollars[50] adjusted to 1976 dollars at an inflation rate of 6¼% per annum. Annual costs are calculated using 8% interest amortized over the nominal life of the septic tank--twenty five years. In calculating the annual costs of septic tank and other systems using fields for disposal, it is necessary to make a judgment of how the costs of land should be included in the annualized costs of the system. Where zoning decisions are made to increase minimum lot sizes to allow for adequate field size, it would be valid to include a portion of the cost of the field in the analysis, assuming some increase in site value for the added land. However, field costs are not included here; land costs are too variable for a sample figure to be meaningful. It is a very simple matter to include land costs as part of the calculations for any given assumptions about the proportionate share of lot costs to be accounted to wastewater disposal. Costs quoted for the disposal fields are for installation of trenches only.

On the basis of these figures, costs for conventional disposal (with alternating field valves) range from about $135 per year in good soils to $326 per year in poor soils, with typical annual costs at perhaps $160 for areas with fair soils. These estimates agree well with those of a 1971 study by Werre conducted in Vermont,[51] which estimated costs in 1971 dollars to vary between $104 and $250 per year. Werre's study also estimated the cost of sewering a typical town, and arrived at costs of $148 to $370 per household,

Table 24

Conventional Septic Tank System

a. 1000 gallon pre-cast tank (25 year life)		$240
b. installation		$330
c. operation		$ 0
d. maintenance (1 pumping/3 years @ $36/pumping)		$ 12/yr.
Annual Cost (a-d)	$82	
e. diversion valve and installation (est.)		$200
Annual Cost (e)	$19	
Subtotal (a-e)	$101	

Disposal Field

f. good soil (170 ft.^{2})		$360
Annual Cost	$34	
g. fair soil (500 ft.^{2})		$600
Annual Cost	$56	
h. poor soil (1600 ft.^{2})		$2400
Annual Cost	$225	

exclusive of government subsidies. Where hilly or rocky terrain exist, typical costs for conventional sewers can be many multiples of this--$10,000 per home is not uncommon.

Aerobic Systems

For the sake of comparison, the same analysis may be done on aerobic systems. Table 24 shows typical costs, and includes the cost of disposal fields because local health departments typically do not relax disposal field requirements assuming that occasional breakdowns of the system will occur. Costs could be adjusted down proportionately to compensate for this, but it is clear that, at present, aerobic units are generally not competitive with anaerobic units on a cost basis.

Table 25

Aerobic System Costs

a.	Equipment costs		
	tank, control panel,etc. (25-year life)		$900
	aeration equipment (10 year life @ $150/unit) 3 units		$450
b.	Installation		$420
c.	Power (annual @ $42)		$1080
d.	Maintenance ($20/pumping every 10 months)		$600
	Annual Cost	$331	
	Disposal Field		
e.	good soil (170 $ft.^2$)		$360
	Annual Cost	$34	
f.	fair soil (500 $ft.^2$)		$600
	Annual Cost	$56	
g.	poor soil (1600 $ft.^2$)		$2400
	Annual Cost	$275	

Other Systems

Clivus Multrum: Prices for the Multrum System as of December 1975, are quoted as $2762 for a completely installed unit, including $600 for an optional side conveyor unit for use where necessary to adapt existing homes to the system. Also included is graywater pretreatment system (trickling filter) and its installation, but field costs for disposal of graywater are not included.

It should be pointed out that this cost includes both a garbage disposal unit and a toilet. Considering that the cost of a toilet (including soil stack) is generally quoted at about $750 installed, this increases the cost competitiveness of the system as a whole. The value of the garbage disposal feature may or may not be accounted as a saving, according to community practice and consumer preference.

There are claimed to be virtually no operations or maintenance expenses associated with the system, although the company has recently modified most installations to include an electric ventilation fan to keep the unit odor-free despite varying atmospheric conditions. Emptying the chamber is done by the owner; removal of the humus that develops at the bottom chamber is said to be an innocuous operation.

Mound Systems: Construction costs for mound systems are currently estimated at between $4000 and $5000, including all pipes, tanks, and pumps.

It may be possible in some localities to avoid mechanical pumping in mound systems if design modifications are made to the plumbing in the house.[52] If bathtubs are raised and toilets are wall mounted on the first floor, enough elevation may be gained to enable the septic tank to be installed above grade and covered with earth. Flow would then be entirely by gravity, and energy and maintenance costs for pumping could be avoided.

TECHNICAL DATA

Recommended Percolation Test Procedures

A percolation test is used to identify a suitable soil stratus for septic-tank practices and to estimate the size a system should be to have a reasonably long lifespan.

Where soils are shallow, percolation-test holes would best be placed at the depth of the proposed disposal field. In deeper soils, it might be ad-antageous to have deeper disposal fields; there, it might be best to place percolation test holes at more than one level. Where very deep disposal pits are contemplated, test holes should be placed in each stratum considered to be useful.

In addition to percolation tests, exploratory holds dug with a backhoe can expose soils in profile. This is worthwhile in evaluating the suitability of a site for septic tank practices.

Logs of soil borings are of value, if descriptions are in terms of a known soil classification system. Coloquial terms should be avoided.

Digging a Test Hole: Dig or bore a hole with handtools either 12" square or 15" in diameter.

If water is in short supply, or if soils tend to collapse, place a perforated pipe vertically in the hole and carefully pack gravel or some other supporting material between the pipe and the hole wall. Perform the test within the vertical pipe and adjust calculations to account for the displacement of water by the gravel or whatever is used to support the sides of the hole.

Preparation of a Test Hole: Remove any smeared soil surfaces from the sides of the hole to provide as natural a soil interface as practical to infiltrating waters. Remove loose material from the bottom of the hole and add an inch or two of coarse sand or fine gravel to protect the bottom from scouring.

Presoaking a Test Hole: Presoak the hole by carefully filling it deeper than about 8" with clean water. Do not drop the water into the hole from much distance above; rather, ease it in gently.

If it is known that the soil has low shrink-swell potential and clay contents are small (perhaps less than about fifteen percent), proceed with the test. If not, let the hole rest overnight.

Measuring a Stabilized Percolation Rate for Soil Suitability Studies: Where soil suitability is the only concern, such as in subdivision studies, the following process would be practical and adequate.

Equip the percolation hole with a float gauge, note the time, and fill the hole with clean water to exactly 6" above the soil bottom of the hole (do not consider a layer of protective gravel as the bottom of the hole). After a period of one hour, measure the water level. Refill the hole to 6" and repeat the process until four determinations have been made. Use the last determination to calculate the percolation rate.

If the percolation rate is less than one inch of water per hour, the soil is unsuitable for customary practices and special considerations must be made.

Report the percolation rate in inches per hour.

Measuring the Stabilized Percolation Rate for Design Purposes: Fill the hole with clean water to exactly six inches above the soil bottom of the hole (do not consider a layer of protective gravel as the bottom of the hole). With a float gauge, and a timepiece, determine the time for the water to recede exactly one inch. Refill and repeat the process until successive intervals needed for one inch to be absorbed indicate that a stabilized rate has been obtained. Do not allow much time to pass between refillings.

Report the stabilized percolation rate in minutes per inch.

Septic Tank Maintenance Permit

As was the case for diversion valves and split fields (see above), the mechanism by which a town may require and implement a septic tank maintenance program will vary considerably, depending on the existence and extent of other regulatory controls (at the state, county, and local level). In particular, the constitutional and "Home Rule" doctrines of a given state may raise rather complicated questions of a municipality's power to exercise a continuing regulatory function such as maintenance permitting. Again, for the purposes of this report, we assume that the town has concluded that the necessary authority and legal powers are available, and that it may lawfully implement and supervise a maintenance permit requirement.

If the town already has in place an effective and comprehensive sewerage disposal ordinance then maintenance permit requirements should probably be inserted in the appropriate sections of that ordinance. In the event that the municipality has no comprehensive sewer ordinance, virtually identical maintenance requirement language can be coupled with a statement of purpose to produce an ordinance which may be implemented independently. In either case, the following model should be helpful in guiding the ordinance drafters. Inclusion of the statement of purposes (bracketed) would depend on pre-existing ordinances. This material is drawn from the work of David E. Stewart, Small Scale Waste Management Project, Environmental Resources Unit, Madison, Wisconsin.[53]

Model Section 1. Septic Tank Maintenance Permit - Purpose:

[It is recognized that proper maintenance of septic tanks will increase the useful life of all on-site sewage disposal systems which rely on soil absorption of septic tank effluent. To further the purpose of increased life of such on-site disposal systems, and to protect the health, safety and welfare of the inhanitants of the town of ________, the town of ______, hereby establishes a septic tank maintenance permit program.]

Section 2. Permit Required.

No owner may occupy, rent, lease, live in or reside in, either seasonally or permanently, any building, residence, or other structure serviced by a private domestic sewage treatment and disposal system; unless the owner has a valid septic tank maintenance permit for that system issued in his name by the _________ (sanitary inspector or zoning administrator). Owner is defined to mean a natural person, corporation, the state or any subdivision thereof.

Section 3. Fee.

A fee of $ ____ shall accompany each application for the septic tank maintenance permit.

Section 4. Permit Application.

Application for a septic tank maintenance permit shall be made to the ________ (sanitary inspector or zoning administrator) on forms supplied by him. All applications shall state the owner's name and address, the address or location of the private sewage system and shall contain the following statement:

> "I certify that on ____ day of ______, 19__, I inspected the septic tank located at the address stated on this application, and I (check one):
>
> ___ pumped all sludge and scum out of the septic tank, or
>
> ___ found that the volume of sludge and scum was less than 1/3 of the tank volume, and I did not pump the septic tank.

____
Signature

____
Sanitary License Number

Section 5. Issuance.

The __________ (sanitary inspector or zoning administrator) shall issue a permit to the applicant upon receipt of the fee and a completed application, properly signed by a person licensed to service septic tanks and stating his sanitary license number. The permit shall include on its face all information contained in the application and shall contain the date of issuance.

Section 6. Validity.

The permit issued under this section shall be valid for a period of two years from the data of issuance.

Section 7. Sale of Property.

When property containing a private domestic sewage system is sold the new property owner, prior to occupying, renting, leasing, or residing in the building, residence or structure served by the system, shall make application for and received a septic tank maintenance permit; however, the system may be used for a period not to exceed 30 days after making application for a permit.

Note that this permitting structure assumes the existence of a licensed septic tank service firm. There is, of course, a potential for abuse or exploitation whenever a private owner's compliance with a permitting standard is based on the opinion or certification of a fee charging third party. In the absence of state licensing and regulatory control of the septic tank service firm, the town may wish to be rather creative in its efforts to ensure integrity in the permit process and protection of the interests of the owners. One approach would be for the town itself to assume licensing or regulatory control over the service. This alternative may, however, encounter very serious constitutional or restraint of trade problems, depending on the state involved. An alterantive would be for the state to assume licensing and regulatory powers. In either case, the model ordinance, code, or statutory language to accomplish licensing would be as follows (the material is again drawn from the Stewart paper):

> Licensing: (a) License; application; fee. Every person before engaging in the business of servicing septic tanks, seepage pits, grease traps or privies in this state (municipality) shall make application on forms prepared by the ___________ (department of licensing) of each vehicle used by him in such business. The annual license fee is $25 for each vehicle for a state resident licensee and $50 for a nonresident licensee. If the _________ (department), after investigation, is satisfied that the applicant has the qualifications, experience, and equipment to perform the services in a manner not detrimental to public health it shall issue the license, provided a surety bond has been executed. The license fee shall accompany all applications. The ________ (department) shall maintain a list of all those licensed under this section and shall make the list available to all interested persons.

The "Qualifications, experience, and equipment" should be defined to include an acceptable septage disposal site, of course.

As a third alternative, the town could create a department charged with the duty of regularly checking private septic systems, and given the power to contract directly with private service firms to pump septic tanks when necessary. The cost of pumping would then be assessed against the property owner. This approach would assure that pumping occurred when, and only when, it was necessary. However, it might raise fiscal problems for the town; more importantly, it might lend to problems related to a town's power to contract with private parties to have work performed. A legal opinion should be received early in such planning.

Diversion Valves and Alternating Fields

The mechanism whereby a town may require that diversion valves and split fields be included in new sewage disposal systems will vary considerably, depending on the present nature of on-site sewage system regulations in the town. In many instances, only minor revisions of existing codes or ordinances will be necessary to include the new structural requirements. In other situations, where existing regulation is either weak or non-existent, the town may be forced to implement an elaborate set of controls in order to incorporate the suggested design standards. In either case, the town or municipality must be certain that the new standards can be mandated in a manner which is consistent with any overriding state or county powers. Thus, depending on existing laws and enabling legislation, it may be necessary in some states to implement the design criteria at a government level other than the municipality.

For the purposes of this report, we assume that the town has the necessary statutory and constitutional power to implement the suggested design criteria without further state or county involvement or authorization. The primary issue facing town officials will, therefore, be the manner in which the design change requirements are implemented. If the town possesses, in place, an elaborate or comprehensive set of standards for the construction of on-site sewage systems, a slight amendment to those standards should suffice. The following language is, therefore, designed to be added to existing ordinance specifications for sewage systems. The material has been taken, with minor revisions, from the Fairfax County, Virginia, Code for Sewers and Sewage Disposal.

Section 1. General Requirements for Composition of Individual Sewage Disposal Systems.

All individual sewage disposal systems installed or repaired shall consist of the following:

(a) Building sewer
(b) Septic tank
(c) Diversion Valve
(d) Distribution boxes
(e) Distribution sewers
(f) Soil absorption system of hereinafter specified materials.

Section 2. Specifications and Location of Approved Building Sewers

[Incorporate existing municipal regulations or standards.]

Section 3. Septic Tank Specifications.

[Incorporate existing municipal regulations or standards.]

Section 4. Specifications and Location of Diversion Valve.

(a) There shall be a diversion valve located in the four inch (or larger) pipe between the septic tank (or aerobic tank) and the distribution boxes. The diversion valve shall be a three-port, two-way valve of approved materials (i.e., resistant to sewage and leak-proof and designed so that the effluent from the tank can be directed to flow into either one of two distribution boxes).

(1) There shall be a manhole from the top of the valve to the ground surface with an appropriate cover to be level with the ground surface.

(2) There shall be provided a handle of proper length, designed so that the valve can be turned above the ground surface.

(b) In lieu of the aforementioned diversion valve any system that can be designed and constructed to conveniently direct the flow of effluent from the tank into either one of two distribution boxes may be approved if plans are submitted to the [Health Director] and he is satisfied that such system is satisfactory.

Section 5. Specification for Distribution Boxes and Watertight Lateral Lines.

[Incorporate existing municipal regulations or standards.]

Section 6. Subsurface Disposal Fields.

[Incorporate existing municipal regulations or standards in such a way as to provide for split fields of adequate size and capacity.]

Where a comprehensive set of on-site sewerage systems controls or design criteria do not exist, the municipality may need to draft and implement a somewhat elaborate sewage disposal ordinance in order to mandate diversion valves and split fields. Naturally, the elements of such an ordinance will vary considerably from town to town and state to state, depending on the contents and coverage of existing sanitary or health codes (state or local) and applicable state or county regulations.

FOOTNOTES

1. J.A. Salvato, "Problems and Solutions of Onlot Sewage Disposal," presented at the Second National Conference on Onsite Disposal, National Sanitary Foundation (NSF), Ann Arbor, Michigan, 1975.

2. Bailey, et al., A Study of Flow Reduction and Treatment of Waste Water from Households, prepared for the Federal Water Quality Administration, DOI, December 1969, page 29.

3. Ibid.

4. J. Kreissl, "Rural Wastewater Research," paper presented at NSF Conference (see Note 1), Ann Arbor, 1975.

5. Ibid.

6. Ibid.

7. J.W. Clayton, "An Analysis of Septic Tank Survival Data from Fairfax County, VA." Journal of Environmental Health 36: 562-57.

8. Ibid.

9. Bailey, et al., op.cit., p. 31.

10. T. Martin, "Septic Tank Systems, The Need for Research," On-Site Waste Management, Volume I, Hancor, Inc.

11. Ibid.

12. Ibid.

13. Ibid.

14. Kreissl, op.cit.

15. Ibid.

16. Alfred P. Bernhardt, Treatment and Disposal of Wastewater from Homes by Soil Infiltration and Evapotranspiration, University of Toronto Press, 1973. Second Edition, Volume One.

17. American Water Works Association.

18. Martin, op.cit.

19. Soil Conservation Service, Soils and Septic Tanks, Agriculture Information Bulletin 349, U.S. Department of Agriculture.

20. Bailey, et al., op.cit.

21. Patterson, et al., op.cit.

22. Gary P. Plews, "The Adequacy and Uniformity of Regulations for Onsite Wastewater Disposal - A State Viewpoint," paper presented at the Second National Conference on Onsite Disposal, NSF, 1975.

23. J.T. Winneberger, "Correlation of Three Techniques for Determining Soil Permeability," paper presented at Individual Sewage Disposal System Workshop, Cincinnati, Ohio, June 1974, in On-site Waste Management, Volume III, Hancor, Inc.

24. Ibid.

25. Ibid.

26. Soil Conservation Service, op.cit.; also Winneberger, op.cit.

27. Bailey, et al., op.cit.

28. Kreissl, op.cit.

29. Kreissl, op.cit.

30. Cited in Clayton, op.cit.

31 Clayton, op.cit.

32. Ibid.

33. Ibid.

34. Ibid.

35. J.T. Winneberger, "The Principal of Alteration of Subsurface Wastewater Disposal Fields," Hancor, Inc., 1976.

36. Ibid.

37. Ibid.

38. Unfortunately, field switching should probably be done more frequently than tank inspection, making it unlikely that the two purposes could be combined in a single visit.

39. Bailey, et al., op.cit.

40. Reference to this device was found only in Bailey, op.cit., and its effectiveness may be overstated in this publication. The general idea of better designed anaerobic units appears valid, though cost-benefit advantages over conventional installations may be minimal.

41. However, according to Kreissl, studies at the University of Wisconsin show no significant difference in the clogging properties of aerobic and anaerobic effluents.

42. Bailey, op.cit.

43. A.P. Bernhardt, "Small Scale Water Units for Soil Infiltration and Evapo-Transpiration," notes of presentation to Suburban Sewage Disposal Conference, Michigan Department of Health, 1972, in On-site Waste Management, Volume I, Hancor, Inc.

44. C.R. Lindstrom, "The Clivus-Multrum System: Composting of Toilet Waste, Food Waste, and Sludge within the Household," in "Water Pollution Control in Low Density Areas," University of Vermont University Press of New England.

45. Converse, Otis, Bouma, Walker, Anderson, & Stewart, "Design and Construction Procedures for Mounds in Slowly Permeable Soils with Seasonally High Water Tables," prepared under grants from the Small Scale Waste Management Program, the Upper Great Lakes Regional Commission, and the Environmental Protection Agency, April 1975.

46. Interpreted from Ibid.

47. Ibid.

48. Mekosh and Rainos, Pressure Sewer Demonstration at the Borough of Phoenixville, Pennsylvania, prepared for the Office of Research and Monitoring, U.S. Environmental Protection Agency, Washington, D.C., July 1973.

49. Ibid.

50. R.J. Otis, "The Performance of Septic Tanks and Aerobic Treatment Units under Field Conditions," in On-site Waste Management, Volume IV, Hancor, Inc.

51. M.A. Werre, "Feasibility Study of Technical Alternatives in Norwich, Vermont," in Proceedings of Sewage Treatment in Small Towns and Rural Areas, A conference address primarily to the State of Vermont, Thayer School of Engineering, Dartmouth College, Hanover, New Hampshire, March 3, 1971.

52. Otis, op.cit.

53. David E. Stewart, "Legal, Planning and Economic Considerations of On-Site Sewerage Systems," prepared for the Small Scale Waste Management Project, University of Wisconsin, 1974.

SECTION V

STORMWATER MANAGEMENT

STORMWATER MANAGEMENT AND ENVIRONMENTAL QUALITY

Although we retain here the conventional term "stormwater," it is in the broader context of general pollution control that the term is applied. Stormwater management at the local level traditionally has two spheres of concern: limitation of erosion and sedimentation, and flood control. Pollution within stormwater, other than its sediment (soil) content, has received little notice as a local issue. Toxicants and other substances associated with human activities are contained in storm runoff wherever development occurs, and control of these substances is now an objective of Areawide Wastewater Management Planning under Section 208 of the Water Pollution Control Act Amendments of 1972 (P.L. 92-500).

From the point of view of the Environmental Protection Agency, the term "stormwater" is largely replaced by "non-point source" water pollution. When dealing with ambient water quality on a large scale, the major distinctions to be made among sources of water pollution are between discharges of sanitary and industrial wastes at specific outfalls (point sources) and discharges of pollution into receiving waters in the form of generalized runoff from the land, carrying with it heavy lodas of urban and agricultural wastes. It is becoming increasingly clear that non-point source runoff typically contains extremely heavy pollutant loads, and that the goals of the Water Pollution Control Act cannot be met until effective programs are in force controlling it.

This section emphasizes the control of pollutants that contaminate stormwater, and makes a distinction between management techniques aimed at controlling flood hazards and techniques to reduce the pollutant content of runoff. Flood control is separate from the concerns of EPA in its Areawide Wastewater Management Planning Program ("208 Planning Program"), as it interacts with pollution control goals. Pollution control--especially the source reduction of residuals--is the focus of this chapter. Fortunately, general approaches to sedimentation and erosion control developed by local governments over the past years are directly applicable to the management of stormwater pollution, or can be adapted to it with a minimum of difficulty.

Flood Control Versus Erosion/Sedimentation Control

Flood control is important for obvious reasons: although floods are a natural phenomenon, they cause great damage to property and are a threat to life. It is an appropriate function of government to protect citizens from these dangers, and this has traditionally been accomplished in two ways--either by constructing physical barriers against flood waters (dams, dikes, levees, channels, etc.) or by preventing the construction of buildings and habitations in flood-endangered areas. The first approach is expensive, and often has undesirable side-effects--for instance, dams silt up, cause destruction of natural environments, and may tend to encourage development where it is environmentally unsuitable (such as in floodplains where water tables are high). In the long run, flood control engineering may fail, causing greater destruction of property that might have occurred without "protection" if the land had not been developed. The second approach--control or prevention of development in flood-prone areas--is preferred today, as evidenced by the National Flood Insurance Program under the U.S. Department of Housing and Urban Development.

Unfortunately, it is impossible to maintain a neat distinction between the two approaches; development of land in nominally flood-safe areas may lead to increased flood potential both locally and in the region. Engineering and design controls to prevent this danger are necessary in many areas, and are often the major intent of what is now referred to as "stormwater management." This is a fairly recent term,[1] and usually implies comprehensive measures meant (1) to limit the rate and volume of runoff from property for flood control purposes, and (2) to trap eroded soils and prevent sedimentation and eutrophication of streams.

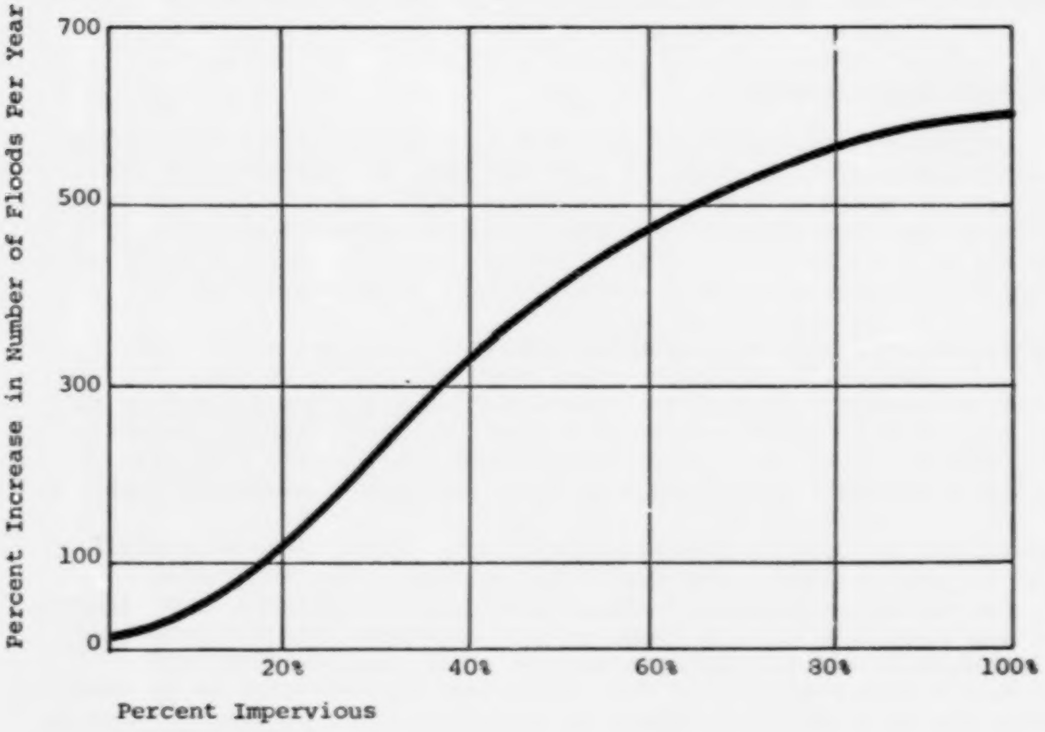
Urban development tends to exacerbate flood peaking problems. Greater percentages of impervious surface prevent enormous volumes of rainfall from being absorbed by the soil, and also accelerate its lateral travel toward receiving streams. Figure 11 shows the percent increase in the number of floods with different degrees of urbanization.[2]

One of the standard.approaches for correcting the tendency of urbanization to accelerate peak is to retain stormwater on site, allowing it to runoff at a rate not exceeding that under "natural" (i.e., undeveloped) conditions. This can be done through a variety of controls, implemented through municipal ordinances. Some of these controls seek to increase infiltration of rainfall into the ground, but in most instances there will still be excess runoff that cannot be disposed of in this way--the limited disposal area will become saturated, at least during more severe storms. In such cases, detention of stormwater on site is advocated, with a controlled release rate equal to that under natural circumstances for the site, considering slope, soils, etc. The detention facilities serve a double purpose: they also allow eroded soil to settle out and be recovered before stormwater is released, and thus would be recommended as part of a pollution abatement program for stormwater.

Potential conflict arises, not over the rate at which stormwater is released, but over its total volume. Depending upon the position of a municipality in a river basin, too much detention of stormwaters may preversely aggravate the flood peak: while the rate of discharge from controlled areas may be "natural," the additional volume of rainfall captured by expanses of impervious surface will prolong the time over which the detailed discharge occurs. The flood peak arriving from upstream--itself perhaps accelerated by

FIGURE 11

PERCENT INCREASE IN NUMBER OF FLOODS AT VARIOUS LEVELS OF URBANIZATION



Source: "Hydrological Data for Land Planning," Luna B. Leopold, January 1967. Flood is defined as overbank discharge. Data are calculated for a drainage area of one square mile.

urbanization--may then combine with this artificially prolonged discharge from the controlled area to exaggerate the total flood peak to hazardous levels. Whereas under truly natural conditions the runoff from the downstream area would long since have subsided, the detained runoff--being much greater in volume than under natural circumstances--now compounds the flooding problem.

It is the purpose of comprehensive floodplain management to take such interactive effects into account, and to produce a coherent management program for minimization of possible flood damage. This can seldom be accomplished by a single municipality acting alone, as river basins are seldom contained within the boundaries of single local governments. Therefore, although detention of stormwater is desirable for sedimentation and pollution control as well as for flood control, it may be important in some cases to set maximum as well as minimum requirements for stormwater detention on-site. As a general rule, runoff from storms greater than the two-year storm should not be detained on-site unless a comprehensive floodplain analysis calls for it.

Water Pollution and Stormwater

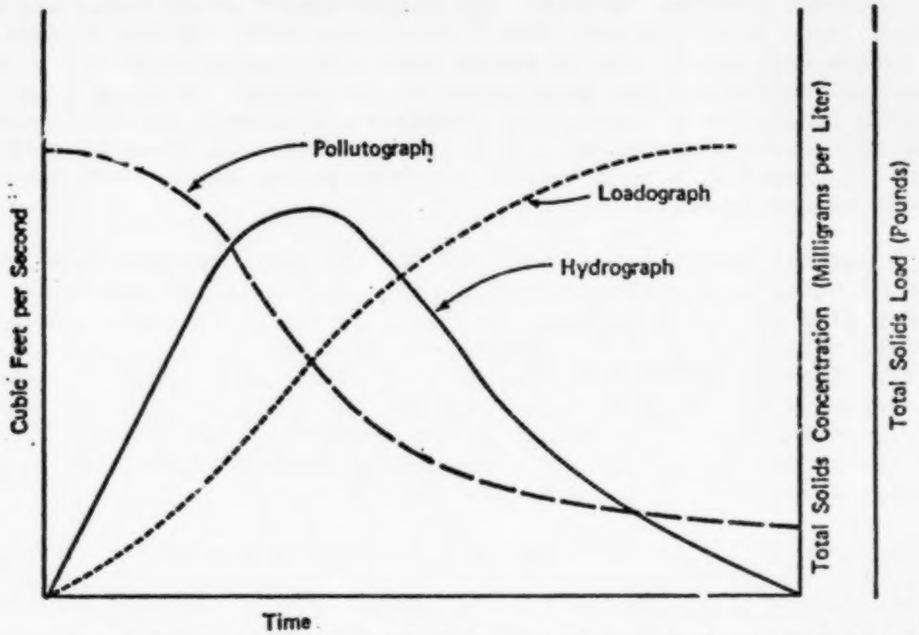
The "pollutant" most commonly associated with stormwater is sediment—i.e., eroded soils. Loss of soils is to be avoided, not only because it represents a loss to agriculture and property values, but also because it causes eutrophication and obstruction of streams. Soil is picked up when small particles are dislodged by impinging rain drops; a great number of other substances are also picked up as well, though in much smaller quantities.

A great deal has been written about erosion and sedimentation control measures. Of interest in this chapter are other pollutants carried by stormwater. EPA has recently completed a study entitled Water Quality Management for Urban Runoff[3] that documented other pollutants contributed to stormwater by urban surfaces. While the report is technical, many of its conclusions have importance to local policymakers in their stormwater management planning.

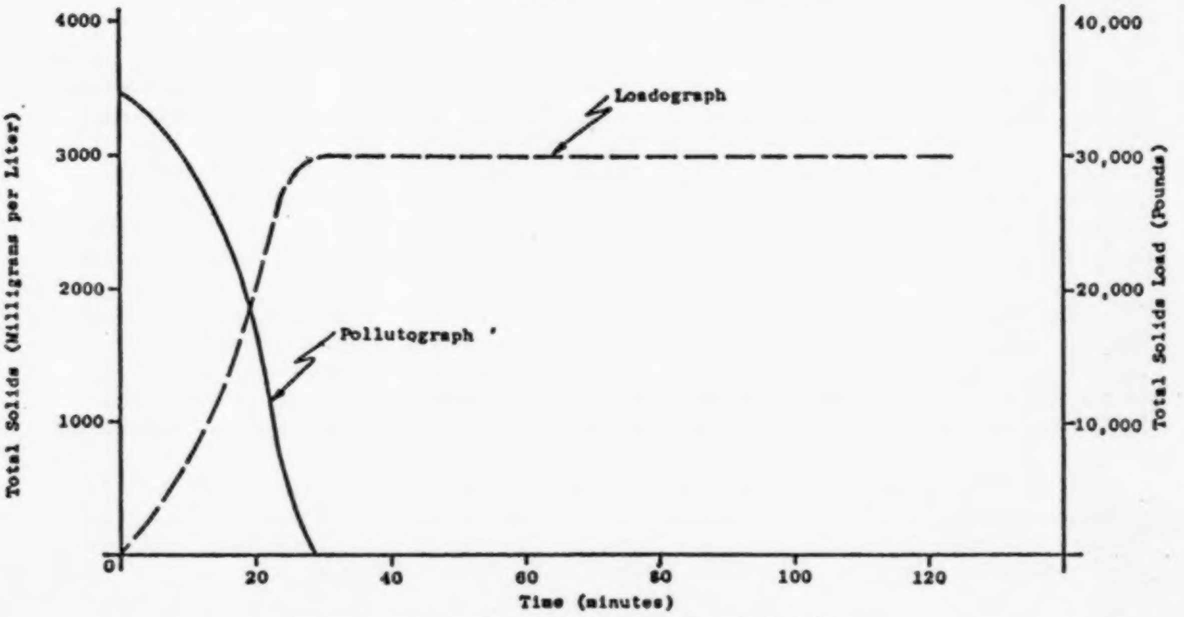
Contaminants of many kinds accumulate on urban surfaces from dustfall, littering, leakage from cars, and many other sources. When rain falls, the energy of raindrops striking surfaces dislodges contaminants from streets, rooftops, and sidewalks; some of these go into solution, others remain suspended. Ultimately this pollution is carried by stormsewers into local receiving waters (see also Section II). Pollutant concentration is greatest at the beginning of a rain, and tapers off rapidly. Thus, programs to control pollution in stormwater are concerned with frequent, low-intensity storm events, not rare, high intensity storms that contribute to floods.

Figure 12 shows the process graphically. The hydrograph curve shows the rate of runoff from a surface as a function of time, measured at a specific outlet from the surface, for a specific storm event: at the beginning of the rain, flow at the inlet is zero; it rises to a peak rate, then tapers off to zero again sometime after the conclusion of the storm. The pollutograph shows the pollutant concentration in the runoff as a function of time, and the loadograph shows the cumulative pollutant load released over the same period. A sample "quantity/quality" hydrograph, worked out with the

Figure 12 : Graphic Representation of Stormwater Runoff Pollution



A Sample Quantity/Quality Hydrograph Comprising a Hydrograph, a Pollutograph, and a Loadograph



Example of Pollutograph and Loadograph

SOURCE: EPA, Water Quality Management Planning for Urban Runoff.

methodologies developed in the report, is shown in Figure 12.

The exact makeup of actual stormwater contaminants varies widely between cities, but a number of studies conducted over the past twenty or more years have produced alarming results. One comprehensive study conducted between 1962 and 1964 in Cincinnati, Ohio,[4] found that BOD5 and COD figures for stormwater were comparable to sewage treatment plan effluent, and that suspended solids content was about equal to raw sewage. A study from the American Public Works Association conducted in Chicago in 1976[5] examined the water pollution potential of street litter alone, and found that this litter alone, if washed away by a typical two-hour storm, would yield BOD5 loadings of 160% of raw sewage.

A more extensive study conducted for the Environmental Protection Agency,[6] which used advanced techniques to duplicate the action of rainfall on very fine particles (ordinarily missed by the collection techniques of previous studies), found even worse potential for pollution from street runoff. Example calculations for a hypothetical city based on extensive data gathered by the study, are presented in Table 26; street runoff is found capable, in the first hour of a moderate to heavy storm, of creating load peaks "many orders of magnitude greater than the same city's untreated sanitary sewage during the same time period."[7]

Streets in industrial areas were found to be particularly contaminated; commercial areas rated below average, as did upper income residential neighborhood, but streets in fair to poor condition averaged two and one-half times greater pollutant loads compared to streets in good to excellent condition.[8] Ninety-five percent of the pollutant loadings were found to lie within forty inches of a curb.

The study also examined other, more toxic, contaminants in street runoff, such as heavy metals, highway deicing salts, grease and oil, and pesticides. Heavy metal pollution was found to be highest in industrial and commercial districts, and in cities with high particulate levels of air pollution. Concentration of metals in runoff was found to be ten to one-hundred times greater than in sanitary sewage,[9] but not so great that it would upset treatment plants if it were treated. Copper, cadmium, zinc, and lead levels were found to be high enough in street runoff to kill certain aquatic organisms.

Highway deicing salts were common in the runoff from northerly cities during certain times of the year. Although they may have a significant impact on lakes and streams, their influence on major rivers was estimated to be small.[10] The impact of certain special additives often found in deicing salts, such as cyanides and chromate compounds, could not be evaluated.

The content of pesticides in stormwater was found by the study to vary widely; extensive data were not collected, and average figures would be misleading. Table 26 represents the data on chlorinated hydrocarbons and mercury concentrations in collected street dirt from nine U.S. cities.

Table 26

Calculated Quantities of Pollutants Which Would Enter Receiving Waters in a Hypothetical City*

	Street Surface runoff (following 1-hour storm) (lb/hr)	Raw Sanitary Sewage (lb/hr)	Secondary Plant Effluent (lb/hr)
Settleable plus suspended solids	560,000	1,300	130
BOD_5	5,600	1,100	110
COD	13,000	1,200	120
Kjeldahl nitrogen	880	210	20
Phosphates	440	50	2.5
Total coliform bacteria (org/hr)	$4,000 \times 10^{10}$	$460,000 \times 10^{10}$	4.6×10^{10}

NOTE: Since the above calculations were based only on a 5-day accumulation of street litter, the above discharge of contaminated runoff could conceivably occur many times in a year.

*The hypothetical city has the following characteristics:

- Population - 100,000
- Total land area - 14,000 acres
- Land use distribution: residential - 75%
  commercial - 5%
  industrial - 20%
- Streets (tributary to receiving waters) - 400 curb miles
- Sanitary sewage - 12 mgd.

SOURCE: EPA, Water Quality Management Planning for Urban Runoff.

Results such as these suggest the importance of controlling pollution in stormwater runoff, but it is difficult to estimate the impacts of these pollutants on the ambient physical environment. Both short term and long term effects are involved, and neither is documented well at present:

> Short Term Effects: Storm events produce short term impact loads of pollutants on receiving waters, often of far greater concentration than continuing pollutant loads contributed by sewage treatment plants and other point sources. These impact loads can have a catastrophic effect on living organisms in the water: average population levels in receiving streams may, therefore, be more dependent on stormwater pollutant loads, which occur sporadically, than they are on chronic pollutant loadings.[11]
>
> Long Term Effects: Pollutants entering the food chain through discharges into streams and rivers have a number of long term effects on the health and generic structure of living organisms, many of which are still inadequately understood. A portion of the contaminants introduced into the food chain will ultimately be consumed by man, causing damage to human health and/or destruction of valuable food supplies.

On the basis of data such as that gathered in the studies mentioned above, 208 Planning Agencies are placing control of non-point source pollution on the list of priorities for areawide wastewater management. Strategies for stormwater pollution abatement appropriate for application by local governments, whether or not they lie in the jurisdiction of a 208 planning area, are outlined below

Groundwater Depletion

Increases in impermeable surfaces due to development activities result in reduction of groundwater recharge on a site, unless special measures are taken to retain rainfall and introduce it into the water table. Roadways, sidewalks, housing, and even landscaping all act to shed water rather than retain it and allow a portion to seep into the ground. Steep slopes, which tend to shed water rapidly in their natural state, do so even more quickly when impervious surfaces are expanded. Ground that is stripped during development may also dry out and harden, reducing its porousity, and the passage of construction machinery on a site may compress the soil and produce the same effect.

Many erosion and sedimentation ordinances now in effect around the country specify that discharge of runoff from a developed area should not exceed the rate under "natural" conditions (see below), but this does not mean that absorption of water into the ground necessarily remains the same as it was before, for the duration of the runoff may be longer than it is under natural conditions. Efforts to maximize recharge of groundwater are important wherever it is used as a supply of drinking water, and in extreme cases to prevent subsidence of the land. It is also beneficial for flood control, and for maintenance of dry weather stream flow, in which groundwater plays a major part.

STORMWATER MANAGEMENT CONTROLS

The stormwater management controls described here share one or more of the following goals:

- Erosion/sedimentation control
- Abatement of pollution from street runoff
- Maximization of groundwater recharge.

The interactions of many municipal ordinances on stormwater management are complex. Parking controls, controls of on-site sanitary wastewater disposal, and solid waste management practices all have an impact on stormwater management and water quality. Readers are referred to those chapters for further reference.

Erosion and Sedimentation Controls

Erosion is caused by a wide variety of factors, natural as well as artificial. Natural factors include soil and rock types, steepness of slopes, intensity and frequency of rainfall, and type and extent of vegetation. Human activities affecting erosion include agricultural and forestry practices, flood control systems, and urban development, both in construction and afterwards. Erosion attributable to human endeavors is, unfortunately, vastly greater than that which occurs under natural circumstances, especially where agriculture and urban development are concerned. Both of these activities strip the soil of protective vegetation, reducing its capacity to trap and hold water just when it is most susceptible to erosion.

Catastrophes such as the Dust Bowl of the 1930's are now being avoided by more enlightened agricultural soil management, but according to a possibly conservative estimate of the American Water Resources Association, over $14 million is still spent every year simply to remove sediments from our water supplies.[12] Much of this comes from urban development--over one hundred times as much soil is lost from land under development than from land in farming.[13]

Erosion and sedimentation controls are applied in a growing number of communities to reduce the loss of soils from construction sites and developed areas. Often approvals for construction are contingent on the use of approved controls. Although these controls may be familiar to many readers, they are reviewed here because some of them may be adapted for use in controlling other forms of pollution from urban surfaces. Several states, including Pennsylvania, Maryland, New Jersey and Michigan, have set up statewide programs for erosion and sedimentation control, and have published manuals for use in concert with local ordinances that present in detail actual construction measures to be used. The Soil Conservation Service is another invaluable source of technical advice. The following summary of basic technical measures will familiarize the reader with current practice.[14]

Delaying Runoff--

A basic approach to erosion and sedimentation control is to delay runoff on-site, gradually allowing it to enter the storm drainage system over a longer period of time and thus limiting the maximum flow rate discharged to streams, and its erosive potention on the site.

(1) Terrace, diversions, runoff spreaders:
These measures increase the time of concentration for stormwater, allowing it to flow at nonerosive velocities over vegetation. Concentrated flow is changed to sheet flow. Groundwater recharge is enhanced, erosion reduced.

(2) Rooftop measures:
Flat roofs may be made to retain water for a substantial period by the use of gravel barriers (which act as levees) or by the use of roof drains with ponding rings. Sloping roofs may use "findams" which act to make the slope over which rain flows longer and more gradual, though water cannot be retained very long--this option is useful where short intense storms are common to help reduce stormwater peaking, and can also be used to increase water supply in some cases.

(3) Detention basins, ponding areas:
Sites may be designed with grassy depressions or basins which, though normally dry, retain stormwater after a storm and release it slowly through a restricted outfall into a conventional stormsewer or natural stream. Recreational facilities such as tennis courts are sometimes used in this way. Permanent decorative ponds may be used to the same purpose if they have enough excess capacity on top of their permanent storage to handle stormwater.

(4) Landscape grading:
Grading landscaping to moderate or low slopes slows the velocity of stormwater, minimizing erosion as well as lagging the peak flow.

On-Site Disposal--

A second basic approach is to dispose of stormwater on-site. Groundwater recharge is increased. Techniques include:

(1) Dutch drains:
These are trenches dug in the ground, filled with gravel, and often covered by a tile latice or even grass. Their function is to intercept sheet runoff and hold it to be absorbed in the ground.

(2) Seepage basins, ponds, etc.:
Any of a variety of basins, seepage pits, wells, gravity shafts, tile fields, etc. whose function is to aid groundwater recharge and dispose of stormwater. The range of sizes and capacities is related to site land use, aesthetic considerations, volume of runoff to be handled, and the porosity of the soil. For maximum recharge, the volume of

water held should at least equal the volume of runoff from all impervious surfaces on-site for the maximum local twenty-four hour storm.

(3) Porous paving:
Lattice blocks, modular pavers, and simple bricks may be used to create a porous paving if the underlying soil is porous enough to dispose of rainwater quickly. Porous asphalt is also available for road surfaces: it is still experimental, but may significantly reduce stormwater runoff from large paved areas, simplifying drainage designs. It should not be used where runoff may be heavily polluted, however.

Minimization of Disturbed Areas--
These approaches reduce erosion directly.

(1) Site analysis:
A site development plan should include considerations of soil types, vegetative cover, and topography. Critically erodable soil, steep slopes, streambanks, drainageways, and the like should be identified and left undisturbed if possible. Development should be scheduled to take place during periods of low precipitation and low runoff if possible.

(2) Minimization of stripped areas:
At best, stripped areas should be no larger than immediate construction needs. However, the high mobilization costs of earth moving equipment often require large areas to be exposed at once. Optimum stripping timetables should be developed at each site to prevent unnecessary stripping, particularly for long construction projects spanning several years.

(3) Conservation of topsoil:
Topsoil should be stripped to a depth of 9' and stockpiled. These piles should be seeded if they are to remain longer than a few months.

(4) Seeding and mulching:
Sites under development for more than six months should be seeded. Temporary mulching with straw or other materials can be used to cover sites under active construction. Crushed stone may be laid on heavily trafficked areas. Sod may be used on critical areas.

(5) Cultivation of slopes:
Slopes left bare too short a time to be seeded can be cultivated across the slope to reduce erosion markedly.

Protection of erodable areas--

(1) Temporary diversions; checkdams:
Temporary channels may be set up diverting runoff from erodable exposed areas. These should be designed to handle at least a five year storm at major building sites. Temporary checkdams may also be built to slow runoff velocity in drain channels to prevent gully erosion from occurring.

(2) Slope drains:
Where runoff cannot be diverted from a vulnerable area, temporary or permanent slope drains may be installed to protect the slope. Broad grass channels may be built on long gradual slopes where flows are less than 8 feet per second; temporary sectional downdrains may be used on unstabilized steeper slopes; and downspout slope drains may be installed subsurface on permanent steep pitches. Energy dissipation may be effected by catchbasins in subsurface systems, by riprap or other rough surfaces in surface drainage systems.

(3) Slope stabilization:
Slope stabilization for permanent grades may be effected by mechanical means--retaining walls or slope paving--where vegetative methods are inadequate. Chemical stabilization compounds are also available, and may be considered. Vegetative stabilizing through seeding or sodding is preferred with plant materials selected with regard to soil and climate conditions; duration, quantity, and velocity of runoff; time required to establish cover; and site use. Mulches are used to protect slopes while vegetation is being established.

Sedimentation Control Measures--

A certain amount of sediment will be carried in the runoff from any site. This must be trapped before it reaches any natural watercourse. Runoff must be held temporarily and particles allowed to settle out. The amount of soil recovered depends on the speed of the runoff, the length of time in detention, and the size of the suspended particles.

(1) Streambank protection zones:
The establishment of buffer zones with natural cover, from as narrow as 50' to as wide as 300', allows sediment particles to be caught and held by ground vegetation as sheet runoff approaches the streambanks.

(2) Simple mechanical traps:
Sediment can be recovered simply by damming drainage channels at intervals with sandbags or other obstacles, and allowing soil to settle out. As individual dams silt up, they can be replaced.

(3) Detention ponds:
In addition to their function of detaining runoff and releasing it slowly, detention ponds may function as sediment basins, trapping large quantities of soil before allowing runoff to be discharged. Larger structures may include stone and perforated pipe filters which resist clogging. Sediment basins must be cleaned periodically to maintain their effectiveness.

Appendix V-1 of this chapter contains a good example of an erosion and sedimentation control ordinance that could be enacted in a municipality. The key to any successful local program of erosion or sedimentation control is some sort of permit system that requires every prospective developer to obey specific standards and file an accepted plan for erosion control management before he is allowed to begin earthmoving activities.

Exact methods by which developers are to minimize erosion losses are not usually specified in ordinances, except in general terms. As in the ordinance presented here, reference can be made to a readily available manual, often provided by the state, which delineates a number of technical methods. The choice of which to use is left largely to the discretion of the developer or builder. The value of this approach is that amendments and updates may be added to the manual on the basis of experience and new technology without having to go through the formal process of amending the ordinance. Since the aim is to minimize erosion loss rather than set permissable maxima, this is not a performance-standard approach; it is similar, however, in that it encourages flexible response. An alternative approach is to set up general principles in the ordinance by which permit applications will be evaluated.[15] For instance, the ordinance may state that the minimum practical areas of land shall be exposed at any one time, that natural features shall be preserved, or that steps be taken to design the development in such a way as to minimize erosion potential after construction is complete. Lastly, if a community is particularly confident that it can identify proper control techniques for any particular class of development,[16] exact procedures can be spelled out in the ordinance itself. The first approach is probably most effective, but reauires preparation of or reference to a suitable manual; the second approach is acceptable where competent personnel are available to review permit applications; the last approach is the least flexible of the three, but may be appropriate for certain communities.

Highway Deicing

In 1971, nine million tons of sodium chloride were used for removing snow and ice from roads across the country, and use for 1975 was projected at that time to run to twelve million tons.[17] (This does not include the use of calcium chloride which accounts for about 3.5% of total salts used.[18]) Up until the early 1960s, highway departments depended mainly on the use of abrasives—sand, cinders, washed stone, and screened slag--for treating slippery roads, but the higher efficiency of salts has caused them to take the dominant role in winter road maintenance since then. Highway departments emphasize the improved safety of roads treated with salt, and justify the costs and environmental impact of bare pavement policies during the winter in terms of accidents avoided and lives saved. (See Table 27 for typical costs.)

Studies conducted around the country indicate, however, that the use of salts on roads is excessive. In some areas, salt has been applied at a rate of one-hundred tons per road mile during the winter,[19] and concentrations of chlorides have been found in street drainage as high as 25,000 milligrams per liter[20] (up to 2,720 g/l in stormsewers). Environmental impacts attributable to the use of salts include groundwater contamination, contamination of surface water supplies, and damage to farm supply ponds, roadside soils and vegetation. In addition, salting damages road surfaces and highway structures, and corrodes automobiles.

The seriousness of the damage to the environment caused by salting varies with the intensity of application, but all the effects of salting are not yet identified. Groundwater contamination serious enough to cause the replacement of wells has occurred in New Hampshire; contamination of water supplies in sixty-three Massachusetts communities has been attributed to salting; similar effects have been noted in many other states.[21] Special additives used to prevent caking and for other purposes may have more severe impacts than the salts themselves, according to one EPA report:[22] sodium ferrocynaide is often used, and is known to give off cyanide when exposed to sunlight (ferric ferrocyanide should be used instead.) Phosphate additives are also used, although adverse impacts may follow. Since some of these chemicals accumulate from year to year, the long term impacts caused by additives may be even greater than the current problems indicate.

Communities should reevaluate their salting programs to use the minimum necessary to maintain safe traffic flows, and to focus application at critical areas in road networks. Most highway departments are committed to the "bare pavement" policy, and may characterize reduction in salt use as "trading shrubs for lives." Yet, it is not altogether clear that bare pavement is necessary for highway safety--it is required if dry weather speeds are to be maintained under all conditions, but communities should question whether fifty-five miles per hour must be preserved at all costs. The question has a political dimension--the public reacts strongly when road conditions deteriorate in the winter and commuting times are increased; officials responsible for highway deicing can justify minimum use of salt in terms of savings in application costs, preservation of road surfaces, protection of automobiles against corrosion (which in some states can amount to millions of dollars of private losses annually) as well as environmental benefits, but they must also consider related issues of access for ambulance and fire-fighting equipment.[23]

Storage of salt and disposal of salt-contaminated snow and ice are other issues of significance. Proper siting of depots and adequate covering of

Table 27

1973 Costs of Deicing (Massachusetts Turnpike Figures)

Agent	Application per Lane Mile	Cost per Lane Mile
Salt/NaCl	350 lbs.	$2.27
NaCl/CaCl	350 lbs.	$3.50
NaCl/Sand	1000 lbs.	$1.57

SOURCE: Tourbier, Water Resources Protection Measures in Land Development.

storage piles to prevent contaminated runoff should be observed; appropriate designs are readily available from state highway departments or EPA. Disposal of road accumulations containing chemical deicers should be done to minimize impacts on local water bodies.

Recently interest has been shown in the use of marine salts for deicing purposes--the salts are finer in texture, and act rapidly to melt ice. However, study results indicate that marine salt produce more environmental contamination than mined salts.[24]

If a community continues to use salt (and most in the snow belt may be expected to), it should keep abreast of research in alternate ways to keep roads clear. Abrasives alone may never be considered adequate substitutes for chemical treatments, since they require reduced speeds, and entail increased maintenance in the spring cleaning catchbasins and roadsides. Promising areas of research include the development of polyurethane tire chains (which would not degrade road surfaces), the use of compressed air with a snow plow for more efficient plowing, and the development of hydrophobic substances to reduce the adhesion of ice on pavements.[25]

Combined Sewer Management Practices

Although the emphasis of this chapter is on land use and related controls on the management of stormwater, it is important to deal briefly with the role of sewer systems and opportunities for improvement in operations and design practice. This is a large subject, so this section is meant only as an overview of alternatives open to local governments.

The original purpose of sewers was to drain stormwater runoff from cities to prevent floods. Household wastes were explicitly excluded from storm sewers until the early part of the nineteenth century, when the development of dense industrial cities and the introduction of modern plumbing required the disposal of sanitary wastes through the sewers to protect the public health. This was the origin of the so-called "combined" sewers. As the health effects of sanitary discharges into local waterways became better understood, some cities instituted various levels of treatment of the combined wastes: new sewers were constructed to "intercept" the sewer flows before they reached the stormsewage outfall, and to carry them to newly constructed plants.

New sanitary waste connections were continually added to the old lines as neighborhoods developed, and as existing areas were redeveloped to increased densities. More and more sewer capacity was dedicated to sanitary flows; although some original sections of systems have been upgraded over the years, capacity constraints are common in many of the older systems in operation today: often there is little reserve left to carry the stormwater for which they were originally built. This has led to serious environmental problems, as even minor storms may cause overflows and discharge of untreated sewage to streams.[26]

Both treatment plants and interceptor sewers have usually been designed to handle little more than a system's dry-weather base flow, which consists almost entirely of domestic sewage. Thus, the overall system may have little capacity to handle increased flows that occur during storms, when flows can be fifty or more times what they are during dry weather. Relief points are therefore provided throughout the system which permit the exit of peak flows during storms. Common engineering estimates are that between two and eight percent of the total annual municipal flows are discharged without treatment, an amount not considered significant.[27]

It is clear now, however, that much more pollution reaches receiving streams from combined sewer overflows than was commonly thought. Air pollution is one usually unrecognized source: oxides of sulphur and nitrogen dissolve in rain droplets, and between 500 and 900 tons of particulates fall on each square mile of most metropolitan areas every year.[28] City surfaces are also contaminated with street litter, deicing chemicals, pesticides, animal droppings, and other pollutants which are washed into storm sewers. (For general characteristics of storm sewerage, refer back to Table 26.)

Even beyond this level of contamination, a further burden is placed on receiving waters by what is called the "first flush" effect. Since flow in combined systems is lower during dry-weather periods than during storms, there is a tendency for sediment to collect within the pipes near joints, along long shallow slopes of pipe, and where flow velocities are not high enough to allow constant scouring. This sediment is washed out with the first large storm, and can cause heavy impact loadings on streams--BOD5 concentrations during first flushes may exceed those of untreated municipal sewage.[29] Fish and vegetation that would be able to tolerate lower levels of chronic water pollution will succumb to sporadic high levels of contamination caused by overflows during storms. A comparison of "first flush" and extended flows is shown in Table 28.

The response to the problem of combined sewer overflows has, for the past 25 years or so, been to construct separate sanitary and storm sewer systems in new communities. Economics have also contributed to this decision: while the construction of sanitary sewers may be an immediate necessity, it is often possible to postpone stormsewer construction and rely on natural drainage. Storm sewer systems, therefore, tend to become more and more fragmented as one moves away from older urban centers, and open channel flow of stormwater increasingly common. Integrated programs for both classes of wastewater are seldom undertaken.

Clearly, construction of separate stormsewers, (Or in older communities, programs to separate sewers) cannot solve the general stormwater problem: it was originally thought that separate systems would yield one uncontaminated flow, the "clean" stormwater, and one polluted flow, the sanitary sewage; this is not the case due to the heavy contamination of urban surfaces. In addition, most separate sanitary sewers are de facto combined sewers: infiltration of water through cracks, unauthorized (or in some older communities, authorized) roof drain connections, submerged manhole covers, basement drains, and deteriorated joints causes surges of flow in sanitary sewers during wet weather. Documented increases range from 20% to nearly 500% in some instances.[30] Such surges in supposedly separate systems can

Table 28

Comparison of Quality Characteristics from First Flushes and Extended Overflows of a Combined Sewer (7) Hawley Road Sewer, Milwaukee, Wisconsin

Characteristic	First Flushes mg/l[a]	Extended Overflows, mg/l[a]
Chemical Oxygen Demand	500-765	113-166
BOD_5	170-182	26-53
Suspended Solids	330-848	113-174
VSS	221-495	58-87
Total Nitrogen	17-24	3-6
Coliforms[b]	---	---

a. At 95 percent confidence level.

b. Coliform 1.5×10^5 to 310×10^5/100 ml.

SOURCE: Metcalf & Eddy, Inc., Urban Stormwater Management and Technology, An Assessment, EPA, Washington Environmental Research Center, 1974.

lower treatment plant efficiencies, and often require bypassing untreated sewage directly into receiving waters.

Many separation programs have been abandoned because of the technical difficulty and enormous costs associated with tracing and repairing old combined sewers and building new parallel systems. It has not been until recently (over the last ten years or so) that an understanding of the full dimensions of the pollution problems of stormwater have reinforced the movement away from separation. Alternatives to separation are more promising and economical, though the National Commission on Water Quality has estimated that pollutant abatement efforts to correct the impacts of combined systems will cost $79.6 billion nationwide.[31] There has been a revival of interest in constructing new combined systems, despite their historical problems, in order to achieve at least partial treatment of stormwater. The major current approaches to combined sewer improvements are outlined below. Interested readers are urged to consult the reference listed in the back of this chapter for more detailed information; Regional EPA offices, 208 Agencies and the U.S. Public Health Service should also be consulted by officials making policy decisions in this area.

Source Control--

The first line of defense against pollution associated with stormsewer flows or combined sewer overflows is source reduction, the subject of the other sections of this chapter (see also Chapters II, IV, VII). Approaches include better solid waste management to reduce street litter, improved street cleaning to pick up more of the fine particles that accumulate along curbsides, reductions in the use of deicing chemicals, and strict enforcement of erosion control ordinances. Flow reductions can be implemented through runoff control ordinances specifying standards for allowable areas and impervious surfaces and giving criteria for disposal of stormwater on site.

Separation of Systems--

Separation of sewers can be accomplished (1) by adding a new gravity flow sewer and using the combined sewer as a stormsewer; (2) by adding a new stormsewer and using the combined sewer as a sanitary sewer; or (3) by adding a pressurized "sewer within a sewer" inside the combined sewer. (See Chapter IV On Site Wastewater Disposal, for a discussion of pressure sewers.) Recent studies by EPA[32] indicate strongly that separation of flows is neither economical nor desirable. Table 29 shows comparative cost estimations of sewer separation versus various alternatives in seven U.S. cities.[33] Although separation may occasionally be preferred, both water quality considerations and economics appear to dictate against it in most cases.

Infiltration/Inflow Control--

The oldest sewer systems in this country were often built of brick and mortar, which was not watertight even when new. All systems as they age tend to develop cracks and defective joints which allow groundwater to infiltrate the system and increase wet weather flows. In some areas with high water tables, infiltration is a constant problem. Inflow is the addition of flows through licit or illicit connections from roof leaders, cellar and yard drains, foundation drains, cross connections, and other sources of

Table 29

Estimated Costs of Sewer Separation in Various Cities

Location	Study Area Acreage	Density People/Acre (year)	Estimated cost,[a] $/acre Type 1[b] (gravity)	Type 2[c] (gravity)	Type 3 (pressure)
Boston, Mass.	53 (along Summer St.)	--	150,400	--	204,800
Boston, Mass.	12,000	--	81,800	--	--
Bucyrus, Ohio	2,340	5.5 (1969)	4,930	4,660	--
Chippewa Falls, Wis.	90	--	--	8,420	--
Chicago, Ill.	240,000	--	28,220	--	--
Cleveland, Ohio[d]	13,000	11.7 (1968)	32,300		--
Des Moines, Iowa[e]	1,836	--	6,450		--
Milwaukee, Wis.	157 (along Prospect Ave)	72.0 (1966)	23,330	--	34,330
Sandusky, Ohio[d]	2,205	16.5 (1969)	20,680		--
San Francisco, Calif.	303 (along Laguna St.)	67.5 (1960)	41,210	--	61,140
Seattle, Wash	925 (Southwest District)	--	--	9,740	--
Seattle, Wash.	695 (E.Central District)	--	--	9,950	--
Washington, D.C.	11,741	45.0 (1965)	66,250	--	--
Washington, D.C.	12,800	45.0 (1965)	52,950	--	--
Regional Costs[d,f]					
New England	NA[g]	--	35,580		--
Middle Atlantic	NA	--	24,350		--
South Atlantic	NA	--	24,530		--
Southern	NA	--	16,720		--
Midwest	NA	--	10,710		--
West	NA	--	9,250		--
National Average	NA	--	18,260		--

a. Adjusted to ENR = 2000.

b. Type 1 is constructing new sanitary sewers & using existing combined sewers for storm sewers.

c. Type 2 is constructing new storm sewers and using existing combined sewers for sanitary sewers.

d. Type 1 or Type 2 not identified in report.

e. Combination of Type 1 and Type 2.

f. Average costs.

g. NA = not available.

NOTE: acres x 0.405 = ha

SOURCE: Metcalf & Eddy, Urban Stormwater Management and Technology, An Assessment. op.cit.

supposedly clear water. Both infiltration and inflow take up valuable pipe capacity, increasing the hydraulic loads at treatment plants and, especially in combined systems, leading to more frequent bypasses and overflows.

Inflow must be controlled by city regulatory action. New inflows should be prohibited, and occasionally old ones may be eliminated by more restrictive sewer use regulations. Inflows previously discharged to sewers can be disposed of on-site or diverted to stormsewer systems.

Infiltration control is a complex subject. In new systems, infiltration can be reduced by proper design and selection of system components; thermoplastic pipes (usually PVC, polyvinylchloride) are especially resistant to infiltration. In old systems, a systematic cleaning, inspection, and repair of pipes is necessary; usually pipes are sealed with plastic liners (polyethylene) and repairs made to joints. Thereafter regular cleaning and inspection is required.

Flushing and Polymer Injection--

As indicated above, the first charge of stormwater moving rapidly through a combined sewer after a typical dry spell (four days or more) can produce the scouring of accumulated sediments from a pipe and its relatively instantaneous discharge (less than one hour).[34] into receiving waters. To prevent this, sewers can be flushed out periodically, though the technology to do so is still experimental. Either fresh water can be introduced (e.g. by firehose), or sewage itself can be dammed up and released. Possibly telemetered systems can be developed and installed to flush sewers automatically. The estimated costs for such a set-up are presented as Table 30[35], although telemetry costs are not included. These costs were estimated for a demonstration project and may not be representative for any widespread implementation of this technique in the future.

Polymer injection involves the use of polymer gelled slurry to reduce hydraulic friction in pipes and thus temporarily increase usable capacity during storms. Where lines are marginally inadequate for storm flows, backups and surcharges can be reduced and more of the flow can reach the treatment plant without overflow. The polymers apparently have only nutrient effects on bacteria, and they do not disrupt plant processes. Demonstrations have been conducted in Richardson and Dallas, Texas; a completely automated unit with upstream and downstream flow level sensors cost $146,000.[36] The process is of most use as a temporary measure to mitigate short term problems before a long range solution can be implemented.

Regulators--

The function of regulators in a combined system is to divert wet-weather flows beyond available treatment/interceptor capacity. Improved regulators of many types have been designed to increase the accuracy of control and even to provide a measure of quality control--some can induce hydraulic flow patterns that tend to separate and concentrate solids for treatment. A discussion of these mechanisms is not appropriate here, however.

Storage--

A major strategy in controlling stormwater pollution can be storage of stormwater within the system for later treatment following the storm event.

Table 30

Estimated Flushing Costs for Demonstration Project[a]

Detroit, Michigan

Alternate	1	2
Number of Flush Stations per Lateral	2	4
Area per lateral, acres	9	9
Daily solids removal, percent	61	72
Installed cost of fabric flush tanks	$6,380	$12,900
Cost of telemetry and controls	--[b]	--[b]
Monthly power cost	$2.24	$4.69
Monthly maintenance cost	$115	$229
Capital cost per acre	$708	$1430
Monthly maintenance and power cost per acre	$13.00	$26.05

a. ENR = 2000
b. Not estimated

NOTE: Acre x 0.405 = ha.

SOURCE: Metcalf & Eddy, Urban Stormwater Management and Technology, an Assessment, op.cit.

This can be accomplished by using in-line excess capacity within major conduits of the system (as has been done in Seattle, Minneapolis-St. Paul, and Detroit)[38]; or by constructing lagoons, tunnels, or tanks off-line. Costs for the implementation of these strategies are, of course, highly variable.

Treatment--

Treatment of stormwater or combined sewage can be handled in a variety of ways. Physical treatment measures include sedimentation, screening, flotation, and filtration; these are the most practical and appropriate for treating combined sewage overflows. Biological and physical/chemical treatment may be indicated where higher quality discharges are necessary or where flows are to be reclaimed for other uses (e.g. irrigation). Disinfection can be used in conjunction with these processes to reduce enteric pathogens in the discharge--chlorination is the most popular technique.

Pesticide and Fertilizer Control

Inappropriate application of pesticides and fertilizers can cause environmental damage through the distribution of these materials by the action of stormwater runoff. Fertilizers can contribute excessive nutrients to streams and lakes, causing eutrophication, and they may cause nitrate contamination of water supplies. Pesticides may have both short and long term toxic effects on humans and animals. Municipalities may choose to enact ordinances which limit or ban the use of certain substances, or make use contingent on a local permit.[39]

The impact of fertilizers and pesticides is in large part dependent on the location of the use, as well as on the mode and extent of application. Stream and lake banks are usually especially sensitive areas for application of any substance capable of environmental damage, and use of fertilizers and pesticides might well be limited here as well as on steep slopes, aquifer recharge areas, or wetlands. Chapter VIII deals with the mapping of communities according to environmental sensitivities to human activities; programs may be instituted under a local environmental review process to manage the application of these substances. Enforcement of local restrictions on these materials may be a problem, since it is difficult, if not impossible, to monitor actual application.

IMPLEMENTATION AND COSTS

Management of stormwater requires conscientious and continuing efforts on the part of the community, both in the public and private sectors. Areas of concern for government include:

> Maintenance of Erosion/Sedimentation Programs: This involves review of applications for permits, inspection of construction on site, and enforcement against violations.
>
> Oversight of Winter Road Salting: This requires inspection and maintenance of equipment and applications processes; inspection and maintenance of stockpiles;

review of the content of deicing chemicals to assure that unwanted additives are absent; monitoring of stream and groundwater quality to assess possible contamination; monitoring and disposal of snow and ice.

Combined Sewer Management Practices: The variety of management and design practices mentioned in this section involve continued maintenance of systems. While some innovative practices such as flushing and polymer injections may be handled automatically, increased O/M expenditures are entailed for manpower, machinery and chemicals.

Street Cleaning: Machinery must be maintained in good operating order; parking restrictions must be enforced to permit thorough street cleaning; and street cleaning practices must be monitored to assure maximum removal of litter and dust.

Pesticide and Fertilizer Control: If a pesticide and fertilizer management program is in force, it must be monitored routinely. If a permit system is used, review of permit applications will be necessary, and inspection on-site may be desirable for large scale applications of chemicals.

Areas of concern for the private sector are:

Erosion/Sedimentation Control: Applications for permits will require expenses for plan preparation in conformance with state standards, and time spent in the application process; execution of the plan will entail materials, labor, and supervision expenses in complying with the plan; compliance after construction will involve continued maintenance of erosion and sedimentation control systems.

Road Salting: No direct costs are incurred in the private sector for improved road salting practices; tax money will probably be saved if reductions in salt application are substantial. Indirect costs will be incurred in increased travel time during inclement weather, but substantial damage to vehicles through rusting can be avoided with less salting.

Combined Sewer Management Practices: Costs for this program would be passed on to the private sector through taxes or user charges; no indirect costs would be involved in terms of time or labor expended in this sector.

> Pesticide and Fertilizer Control: Control over the use of these substances may inconvenience private property owners; if development and construction practices are properly guided, however, critical areas may be left undeveloped and restrictions on the use of these materials can be minimized.

It becomes clear that both responsibility and costs associated with stormwater management programs are dispersed through the public and private sectors. Doubts are immediately raised regarding any community's ability to continue to implement an effective program without widespread public acceptance of both goals and methods. Thus, in addition to the responsibilities already outlined, communities may need to inaugurate public education programs aimed at increasing public acceptance and participation in stormwater management programs--particularly in the realm of pollution control. Here, modifications of accustomed building practices, parking patterns, and street cleaning and maintenance operations may be objected to by local citizens.

Costs for the various programs described are dependent on local conditions. Expenses for the review and processing of erosion/sedimentation control plan applications will vary from community to community, according to the extent of the required documentation as well as the number of applications processed. Costs of improved building practices are hard to document: Table 31 gives some example figures from Tourbier's study, Water Resources Protection Measures in Land Development.

ORDINANCES

Recommended Soil Erosion and Sedimentation Control Ordinance

The following ordinance is taken from Model Environmental Protection Ordinances, published by the South Branch Watershed Association, Lebanon, New Jersey. It is used with reference to a manual adopted by the New Jersey Soil Conservation Service for recommended practices in erosion and sedimentation control; similar manuals are available from other sources across the country, and may be referenced in any adopted version of this ordinance. The ordinance has been adopted by various communities, and is said to work well given adequate attention to monitoring and enforcement.

Recommended Stormwater Management Ordinance

Similar to the sedimentation and erosion control ordinance, this stormwater ordinance published in the same volume follows the same manual on sedimentation and erosion control. It involves a permit system for earth moving operations, and is representative of the better stormwater management ordinances enacted nationwide.

Table 31
Costs of Erosion and Sedimentation Control Measures

METHOD	COST (year of estimation)	COMMENTS
On-Site Disposal of Stormwater (groundwater recharge)		
1. Dutch Drains (gravel filled ditches)	$15/cubic yard (1972) ($30 adjusted) (see comment)	Credit usually given for 50% of provided capacity
2. Porous Pavement	$5.50/square yard (1973)	About 1.7 times as expensive as conventional asphalt
3. Lattice Concrete Block Pavement	$9.50/square yard (1972)	About 3 times as expensive as conventional asphalt
4. Infiltration Pits, Trenches, Tile Fields	$11/cubic yard of storage (1972)	Minimum 50 cubic yards
5. Seepage Beds	$9.35 cubic yard of storage (1972)	Require overflow system--for use where percolation rates prohibit infiltration pits
6. Seepage Areas	$5/cubic yard storage (1972)	Shallow disposal areas for multiple use
Erosion Prevention Measures		
1. Removal, Storage, and Replacement of Topsoil	$60/1000 square feet (1972)	Rough maximum cost
2. Diversion and Interceptor Berms	$125/linear foot (1971)	
3. Stabilization of Critical Areas with Sod	$2.50/square yard (1973)	Rough maximum cost for steep slopes
4. Mulching Seeded Areas (seed, fertilizers, straw mulch, tacking)	$200-500/acre (1971)	Costs vary widely according to materials availability and scale economies
5. Grass Channels (handling runoff to 8 fps)	Sod--$1/square yard Seed--$.08/square yard (1972)	

SOURCE: Tourbier, Water Resources Protection Measures in Land Development.

MODEL MUNICIPAL LAND DISTURBANCE ORDINANCE
TO CONTROL
SOIL EROSION AND SEDIMENTATION

An ordinance to establish regulations for controlling soil erosion and sedimentation within the municipality of ________________ ___.

ARTICLE I
TITLE AND PURPOSE

A. TITLE

This ordinance shall be known as the "________________Municipal Soil Erosion and Sediment Control Ordinance."

B. PURPOSE

The purpose of this ordinance is to control soil erosion and sediment damages and related environmental damage by requiring adequate provisions for surface water retention and drainage and for the protection of exposed soil surfaces in order to promote the safety, public health, convenience and general welfare of the community.

ARTICLE II

RULES APPLYING TO TEXT

For the purpose of this ordinance certain rules or work usage apply to the text as follows:

1. Words used in the present tense include the future tense; and the singular includes the plural, unless the context clearly indicates the contrary.

2. The term "shall" is always mandatory and not discretionary: the word "may" is permissive.

3. The word or term not interpreted or defined by this article shall be used with a meaning of common or standard utilization.

B. DEFINITIONS

The following definitions shall apply in the interpretation and enforcement of this ordinance, unless otherwise specifically stated:

1. Applicant - A person, partnership, corporation or public agency requesting permission to engage in land disturbance activity.

2. Critical Area - A sediment-producing highly erodible or severly eroded area.

3. Excavation or Cut - Any act by which soil or rock is cut into, dug, quarried, uncovered, removed, displaced or relocated.

4. Erosion - Detachment and movement of soil or rock fragments by water, wind, ice and gravity.

5. Erosion and Sediment Control Plan - A plan which fully indicates necessary land treatment measures, including a schedule of the timing for their installation, which will effectively minimize soil erosion and sedimentation. Such measures shall be in accordance with standards as adopted by the State Soil Conservation Committee.

6. Farm Conservation Plan - A plan which provides for use of land, within its capabilities and treatment, within practical limits, according to chosen use to prevent further deterioration of soil and water resources.

7. Land - Any ground, soil, or earth including marshes, swamps drainageways and areas not permanently covered by water within the municipality.

8. Land Disturbance - Any activity involving the clearing, grading, transporting, filling and any other activity which causes land to be exposed to the danger of erosion.

9. Permit - A certificate issued to perform work under this ordinance.

10. Mulching - The application of plant residue or other suitable materials to the land surface to conserve moisture, hold soil in place, and aid in establishing plant cover.

11. Sediment - Solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water or gravity as a product of erosion.

12. Sediment Basin - A barrier or dam built at suitable locations to retain rock, sand, gravel, silt or other material.

13. Soil - All unconsolidated mineral and organic material of any origin.

14. Soil Conservation District - A governmental subdivision of this State, which encompasses this municipality, organized in accordance with the provisions of Chapter 24, Title 4, N.J.R.S.

15. Site - Any plot, parcel or parcels of land.

Reproduced from best available copy.

16. State Soil Conservation Committee - An agency of the State established in accordance with the provisions of Chapter 24, Title 4, N.J.R.S.

17. Stripping - Any activity which significantly disturbs vegetated or otherwise stabilized soil surface including clearing and grubbing operations.

ARTICLE III
PROCEDURE

A. REGULATION

1. No land area shall be disturbed by any person, partnership, corporation, municipal corporation or other public agency within this municipality unless; the applicant has submitted to the building inspector a plan to provide for soil erosion and sediment control for such land area in accordance with the Standards for Erosion and Sediment Control adopted by the New Jersey State Soil Conservation Committee and administered by the __________ Soil Conservation District and such plan has been approved; and a valid land disturbance permit has been issued by the building inspector except as exempted by ARTICLE V.

B. DATA REQUIRED

The applicant must submit a separate soil erosion and sediment control plan for each noncontiguous site. The applicant may consult with the __________ Soil Conservation District in the selection of appropriate erosion and sediment control measures and the development of the plan. Such plan shall contain:

1. Location and description of existing natural and man-made features on and surrounding the site including general topography and soil characteristics and a copy of the soil conservation district soil survey (where available).

2. Location and description of proposed changes to the site.

3. Measures for soil erosion and sediment control which must meet or exceed STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL adopted by the State Soil Conservation Committee. STANDARDS shall be on file at the offices of the local soil conservation district and the township clerk.

4. A schedule of the sequence of installation of planned erosion and sediment control measures as related to the progress of the project including anticipated starting and completion dates.

5. All proposed revisions of data required shall be submitted for approval.

C. REVIEW AND APPROVAL

1. Erosion and sediment control plans submitted with subdivision and site plan applications shall be reviewed by the planning board and approved when in conformance with the Standards for Erosion and Sediment Control. - The board may seek the assistance of the __________ Soil Conservation District in the review of such plans and may deem as approved those plans which have been reviewed and determined adequate by the __________ Soil Conservation District.

2. All other types of soil disturbance not exempted in Article V shall come under the review of the municipal public body or designated municipal officer in accordance with their memorandum of understanding with the __________ Soil Conservation District.

NOTE: PLANNING BOARD REVIEW POWERS

The planning boards of New Jersey have explicit statutory authority for their subdivision review powers and have judicial support for their site plan review powers.

There are, however, many other land use matters that reflect on planning and physical development of the municipality over which the planning board has no explicit or implicit review powers.

However, pursuant to the provisions of N.J.S.A. 40:55-1.13, the governing body of a municipality may require the planning board to review and report upon any class of matters, (i.e., soil disturbance other than that associated with subdivisions or site plans) prior to final action thereon by any municipal public body or municipal officer.

Therefore, in instances of soil disturbance other than that proposed in subdivision and site plan applications, the initial enforcement jurisdiction may be delegated to the building inspector with the requirement (by ordinance) that he refer the matter to the municipal planning board pursuant to the provisions of 40:55-1.13 for report and recommendation.

C. **REVIEW AND APPROVAL** (alternate procedure)

Soil erosion and sediment control plans shall be reviewed by the municipal engineer (or other designated official) and approved when in conformance with the Standards for Erosion and Sediment Control.

The municipal engineer may seek the assistance of the ______________ Soil Conservation District in the review of such plans and may deem as approved those plans which have been reviewed and determined adequate by the said district.

ARTICLE IV
PRINCIPLES AND REQUIREMENTS

A. **GENERAL DESIGN PRINCIPLES**

Control measures shall apply to all aspects of the proposed land disturbance and shall be in operation during all stages of the disturbance activity. The following principles shall apply to the soil erosion and sediment control plan.

1. Stripping of vegetation, grading or other soil disturbance shall be done in a manner which will minimize soil erosion.
2. Whenever feasible, natural vegetation shall be retained and protected.
3. The extent of the disturbed area and the duration of its exposure shall be kept within practical limits.
4. Either temporary seeding, mulching or other suitable stabilization measure shall be used to protect exposed critical areas during construction or other land disturbance.
5. Drainage provisions shall accommodate increased runoff, resulting from modified soil and surface conditions, during and after development or disturbance. Such provisions shall be in addition to all existing requirements.
6. Water runoff shall be minimized and retained on site wherever possible to facilitate ground water recharge.
7. Sediment shall be retained on site.
8. Diversions, sediment basins, and similar required structures shall be installed prior to any on-site grading or disturbance.

B. **MAINTENANCE**

All necessary soil erosion and sediment control measures installed under this ordinance, shall be adequately maintained for one year after completion of the approved plan or until such measures are permanently stabilized as determined by the municipal engineer. The municipal engineer shall give the applicant upon request a certificate indicating the date on which the measures called for in the approved plans were completed.

C. **MAINTENANCE BONDS (OPTIONAL)**

1. In the event that certain work required under the permit cannot be performed within the time set for completion and is postponed, a cash bond in form approved by the Borough Attorney in an amount equal to the cost of such uncompleted work may be deposited with the (designated official) to guarantee performance, which amount shall be determined by the Building Inspector. No such permission to postpone work shall exceed six (6) months. Upon failure to complete the work, the (designated official) shall use the money deposited with the Borough to finish the unfinished portion of the work in accordance with the land disturbance permit. Any unpaid portion of the monies deposited shall be returned to the applicant.
2. Prior to acceptance of work performed in accordance with the land disturbance permit, the Building Inspector shall obtain a cash maintenance bond from the applicant. Such bond shall be in an amount equal to fifteen (15) percent of the work performed by the applicant as determined by the Building Inspector. Such bond shall guarantee proper maintenance of the disturbed site for the period required by this Ordinance. Upon expiration of the period of the maintenance bond, the full amount less the costs incurred for maintenance shall be returned to the applicant.

D. **FEES (SUGGESTED SCHEDULE)**

1. Initial application $25.00 per acre or part thereof.
2. Extension $5.00 per acre or part thereof.
3. In addition to the above, the applicant shall pay a reasonable engineering inspection fee upon submission of a voucher by the Municipal Engineer. Said fee shall not exceed $500.00.

E. **PENALTIES (SUGGESTED PROVISION)**

Any person, partnership, corporation, municipal corporation, public agency or other entity violating any provision of this Ordinance shall be subject to a fine of not more than $500.00 and not more than ninety (90) days in jail, or both. Notwithstanding this provision, the (municipality) may proceed to obtain injunctive or other appropriate relief. In the event that construction is involved, the Building Inspector shall issue a "stop work notice" which shall be effective until recinded. In addition to the penalties herein provided, expenses incurred by the (municipality) in repairing or correcting any such violation shall also be recoverable from the violating party.

ARTICLE V
EXEMPTIONS

The following activities are specifically exempt from this Ordinance:

1. Land Disturbance associated with existing one and two family dwellings.
2. Use of land for gardening primarily for home consumption.
3. Agricultural use of lands when operated in accordance with a farm conservation plan approved by the local soil conservation district or when it is determined by the local soil conservation district that such use will not cause excessive erosion and sedimentation.

ARTICLE VI
INSPECTION AND ENFORCEMENT

The requirements of this Ordinance shall be enforced by the municipal engineer who shall also inspect or require adequate inspection of the work. If the municipal engineer finds existing conditions not as stated in the applicant's erosion and sediment control plan he may refuse to approve further work and may require necessary erosion and sediment control measures to be promptly installed and may seek other penalties as provided in Article IV E.

ARTICLE VII
APPEALS

Appeals from decisions under this ordinance may be made to the municipal governing body in writing within ten days from the date of such decision. The appellant shall be entitled to a hearing before the municipal governing body within thirty days from the date of appeal. The municipal governing body may thereafter reserve, modify, or affirm the aforesaid decision.

ARTICLE VIII
REPEALER

All Ordinances or parts of Ordinances inconsistent with the provisions of this Ordinance are hereby repealed to the extent of such inconsistency.

ARTICLE X
VALIDITY AND SEVERABILITY

If any part of this Ordinance is found not valid, the remainder of this Ordinance shall remain in effect.

ARTICLE XI
EFFECTIVE DATE

This ordinance shall take effect immediately upon its enactment and publication in the manner provided by law.

X

STORM WATER MANAGEMENT

This ordinance was developed as part of a regulation storm water management study and plan for three municipalities. The ordinance is currently before the participants for their consideration. It is offered here as a sub-watershed approach to the universal problem of drainage. The concept is suited to semirural and developing drainage basins rather than those already quite urbanized.

The goals to be implemented through the ordinance are:

1. To maintain the integrity of stream channels for their biological functions as well as for drainage.
2. To induce water recharge into the ground where practical.
3. To maintain the present adequacy of culverts and bridges.
4. To lessen non-point pollution through the various detention devices employed.
5. To lessen the threat of flooding by storms normally contained within the banks of the streams.

The run off standard of "good grass land" cover is something less than forest cover but higher than "rotation crops" or "previous cover." The ordinance allows for considerable innovative methodology on the part of the engineer in pursuit of these goals. This may very well become more definitive in a given municipality through experience. Copies of the complete study, Regulation Storm Water Management Study and Planning - Clinton Township, Lebanon Borough, Readington Township are available for $2.50 from the South Branch Watershed Association, 34 Center Street, Clinton. New Jersey 08809.

AN ORDINANCE FOR THE MANAGEMENT OF SURFACE WATER RUNOFF IN THE TOWNSHIP OF ________________ COUNTY OF HUNTERDON - STATE OF NEW JERSEY

ARTICLE I

Title: This ordinance shall be known as the ______________ _________ Township surface water management ordinance

General Intent: The general intent of this ordinance is to manage the increased rate and velocity of surface water runoff created by alteration of the ground cover and natural runoff patterns.

Purposes: This ordinance is deemed essential and necessary to protect the public health, safety and welfare of the citizens of ________________ Township and the surrounding communities by accomplishing the following purposes;

1. Maintain the adequacy of natural stream channels and prevent accelerated bank erosion by controlling the rate and velocity of runoff discharge to these water courses so as to avoid increasing frequency of the bankful stage.
2. Prevent degradation of the stream biota caused by excessive flushing and sedimentation.
3. Prevent degradation of stream water quality due to impairment of the stream's biological function.
4. Enhance the quality of non-point runoff by water retention measures.
5. Preserve present adequacy of culverts and bridges by suppressing artificially induced flood peaks.
6. Reduce public expenditures for replacement or repair of public facilities resulting from artificially induced flood peaks.
7. Prevent damages to life and property from flooding resulting from excessive rates and velocities of runoff.
8. Conserve the taxable value of property by enhancing the environmental character of the streams of the township.

ARTICLE II

DEFINITIONS

APPLICANT - Any person, partnership, corporation or public agency requesting permission to engage in land disturbance activity, construction or development.

APPROVED PLAN - A plan to control surface water runoff which has been approved by the municipal planning board.

CHANNEL - A water course with a definite bed and banks which confine and conduct continuously or intermittently flowing water.

CONSERVATION EASEMENT - An agreement or covenant running with the land which prohibits all land or negetation disturbance in favor of a permanent dedication to natural open space; each agreement to be entered into between the applicant and the municipality.

DRAINAGEWAY - Any water course, trench, ditch, depression or other hollow space in the ground, natural or artificial, which collects or disperses surface water from land.

ENVIRONMENTALLY CRITICAL AREA - Any area which should not be disturbed by uses incompatible with the paramount public interest in the prevention of surface water runoff and attendant environmental damage. Examples of environmentally critical impact areas include but are not limited to lakes, ponds, flood plains and flood hazard areas, designated stream corridors, steep slopes, highly erodable soil wetlands, swamps, marshes, bogs, acquifer recharge and discharge areas, and heavily wooded areas.

LAND DISTURBANCE - Any activity involving the clearing, grading, transporting, filling of land and any other activity which alters land, topography or vegetative cover.

'MEADOW OF GOOD HYDROLOGIC CONDITION' - As defined by sheet RTSC-NE-Engineer 200, sheet 1 of 2 published by USDA-SCS February 1970.

NATURAL DRAINAGE FLOW - The topographical pattern or system of drainage of surface water runoff from a particular site, including the various drainage ways and watercourses which carry surface water only during periods of heavy rains, storms or floods.

NON-POINT RUNOFF - Surface water entering a channel from no definable discharge source.

SEASONAL HIGH GROUNDWATER TABLE - As shown on map subject to field investigation

SURFACE WATER - All water produced by rain, flood, drainage, springs and seeps flowing over the land or contained within a natural or artificial water course.

SURFACE WATER RUNOFF - The dispersion or drainage of surface water by natural or artificial means.

alt: (any overland flow of water across the ground surface to the nearest conduit)

SURFACE WATER MANAGEMENT PLAN - A plan consistent with the purposes and policies of this ordinance which fully indicates necessary land treatment measures and techniques including a schedule for implementation and maintenance.

SURFACE WATER RUNOFF DAMAGE - All damage or harm to property values, land, vegetation and water supplies, including but not limited to, flooding, soil erosion, siltation and other pollution of watercourses, and diminished recharge of ground water supply which damage results or is likely to result when the dispersion of surface water typical of the land in a 'meadow of good hydrologic condition' is increased in rate, velocity or quantity.

WATERCOURSE - Means rivers, streams, brooks, waterways, lakes, ponds, marshes, swamps, bogs and all other bodies of water,natural or artificial, public or private which are contained within, flow through or border on ____(municipality)________ or any portion thereof.

WATERSHED - An area of surface water runoff related to a point of conventration (such as the topographically determined confluence with another body of water or a man made culvert etc.) as shown on Map # _______ Watersheds Overlav. Regional Natural Resource Inventory Report 1974.

10, 15 or 100 YEAR STORM - The most intense probable precipitation to occur in a given region in a 24 hour period, with a frequency of once in 10, 15 or 100 years.

ARTICLE III

ADMINISTRATION

A. Applicability - A surface water management plan shall be approved by the Planning Board prior to site plan approval, special exception, zoning variance, issuance of building permit, preliminary subdivision approval or any other land disturbance activity as the case may be.

No person shall engage in any land disturbance activity or any property within the township without having submitted a surface water runoff management plan together with erosion and sediment control plans to the planning board and obtaining approval of such plan and a permit or written waiver of necessity from the planning board.

B. Waiver - The Planning Board may waive the need for a surface water management plan for plots of two acres or less upon written recommendation of the municipal engineer certifying there is no appreciable increase anticipated in rate or velocity of runoff based on plans submitted.

C. Exemptions - The following are exempt from the provisions of this ordinance:

1. Site plans for development where the negetative cover of the land will not be disturbed.

2. Agricultural use of lands when operated in accordance with a farm conservation plan approved by the local Soil Conservation District.

D. Planning Board Approval - The surface water management plan or any major amendment shall be approved by the Planning Board in the manner and form and according to the regulations hereafter set forth.

The Planning Board in approving said surface water management plan may impose lawful conditions or requirements designated or specified on or in connection therewith. These conditions and requirements shall be provided and maintained as a condition to the establishment, maintenance and continuance of any use or occupancy of any structure or land.

E. Minor Amendments - Minor amendments to a surface watermanagement plan may be approved by the Municipal Engineer who shall notify the Planning Board of the nature and reason for the change.

F. Enforcement If at any time the municipal engineer finds existing conditions not as stated in the applicant's approved plan the planning board or its designated agent shall order cessation of all work and seek to enjoin the violation or take such steps looking to the enforcement of the plan as may be lawful.

ARTICLE IV

STANDARDS

A. General Standards - In the preparation of a surface water mangement plan, the following general principles shall be adhered to:

1. The rate and velocity of runoff from the site following completion of the planned development shall not exceed that which would prevail under total coverage in a Meadow of good hydrologic condition, (permanent meadow) as defined by Soil Conservation Service Standards, or previous cover, whichever produces the least amount of run off.

2. Maximum use shall be made of presently existing surface water runoff control devices, mechanisms or areas such as existing berms, terraces, grass waterways, favorable hydrologic soils, swamps, swales, watercourses, woodlands, floodplains, as well as any proposed retention structures.

3. Whenever practicable, cluster development (based upon standards in Section ____ of the zoning ordinance) shall be employed and permitted if it will reduce the total area of impervious surfaces, preserve open space and topographic features critical to surface water mangement.

4. Evaluation shall be made of the nature of the subwatershed of which the site is a part, the receiving stream channel capacities and point of concentration structure as shown on the Base Maps showing roads, streams, culverts and bridges and described in report Stormwater Management Study, June 1, 1973.

5. Surface water runoff shall not be transferred from one watershed to another.

6. The plan should coordinate with the soil erosion-sediment control plan and, where applicable, the critical area ordinance and tree protection ordinance provisions shall be adhered to.

7. To the greatest possible extent the plan shall avoid the concentration of flow and shall provide for dissipation of velocities at all concentrated discharge points.

8. Re-establishing vegetative cover shall be in accordance with "Standards and Specification for Soil Erosion and Sediment Control in New Jersey" adopted by the Hunterdon County Soil Conservation District, latest edition.

9. Timing for the plan shall establish permanent surface water management measures prior to construction or other land disturbance, to include seeding and establishing sod or grass waterways.

B. Design Standards - For engineering revue by municipal engineer

1. For calculating runoff and controls either of the following methods may be used in computing runoff: "Soil Conservation Service Method" under USDA or the "Rational" method.

Criteria	SCS Method	Rational Method
Surface conditions	Meadow	average cultivation or light growth R = (0.20 to 0.40)
Collection system	15 year storm	15 year storm
Storage	100 year storm	100 year storm
Outlet discharge	10 year storm	10 year storm
Emergency spillway	100 year storm	100 year storm
Soil Type	A, B, C, D as determined by Map (Hydrologic soils) (title)	loam
Maximum velocity at pipe outlets	4 FPS	4 FPS
Intensity	SCS Method	Water Policy rainfall curves

2. All outfalls are to be designed in a manner to retard velocities at the outfall and provide stream channel protection.

3. When a natural drainage pattern is necessarily intercepted, as by a street, this shall be considered.

4. All structures and land treatment practices shall conform to "Standards and Specifications for Soil Erosion and Sediment Control in New Jersey" latest edition adopted by the Hunterdon County Soil Conservation District.

5. All water carrying structures and/or retention areas shall be completed and stabilized prior to diversion of water to them.

6. As preliminary to developing the surface water management plan there shall be an inventory of the site showing all existing natural and manmade drainage related features as listed in Article IV:3. (berms, terraces, grass waterways, favorable hydrologic soils, poorly drained soils, swamps, swales, watercourses, woodlands, floodplains). These shall be incorporated in the plan to the greatest possible extent in accordance with their functional capability.

7. Drainageways and watercourses which normally carry or receive surface water runoff shall not be overloaded with increased runoff, sediment or other pollution resulting from disturbance of soil and negotation or incident to development, construction or other activity.

8. Due consideration shall be given to the relationship of the subject property to the natural or established drainage pattern of the subwatershed(s) of which it is a part as shown on Map, Watersheds Overlay, ____________ Township, Stormwater Management Study, June 1, 1973.

9. Surface water runoff controls shall be designed to assure that the land in question uses no more than its proportionate watershed share of the natural stream and culvert capacity as set forth in tables, Appendix C Stormwater Management Study, June 1, 1973 or as ascertained by field measurements.

10. The curbing requirement may be relaxed by the municipal engineer in the interest of acceptable drainage accommodation that will relieve concentration of flow or discharge to a stormwater sewer system.

11. Inovative surface water runoff control and recharge devices may be proposed such as rooftop storage, drywells, cisterns, roof drain infiltration trenches, provided they are accompanied by detailed engineering plans and performance capabilities.

ARTICLE V

DATA REQUIRED

The applicant shall submit a separate surface water management plan for any proposed lot, subdivision, cluster development, site plan review, special exception, zoning variance or any land disturbance activity except as exempted in ARTICLE III: B and C. The surface water management plan shall be coordinated with the soil erosion and sediment control plan required by the Soil Erosion and Sediment Control Ordinance.

Such plan shall contain:

1. Lot and block numbers of the site as shown on the current tax map of the township.

2. Name and address of the owner of the land.

3. Size of subwatershed and location of the site within the subwatershed(s) as shown on Map ____________ referred to in Report ____________ 1973.

4. Location, description and quantification of significant natural and manmade features on and surrounding the site, including topography, all impervious surfaces, soil and drainage characteristics, with particular attention to the location and description of presently existing surfacewater runoff control devices, mechanisms or areas, swamps, flood plains, swales, woods and vegetation, steep slopes and other features critical to the purposes of this ordinance.

5. Size of nearest culvert or bridge downstream of discharge area, profiles and cross section of stream channel upstream of that structure as inventoried in Report ____________ 1973 as well as profiles and cross sections of stream channel at all points of proposed surface water discharge from the site, as required by the municipal engineer.

6. Location, description and quantification of proposed changes to the site whether of a permanent or temporary nature with particular attention to impervious surfaces and interception of presently dispersed flow which may impact upon the capacity of the soil, vegetation cover and drainage ways to absorb, retard, contain or control surface water runoff.

7. Designation of critical or other areas to be left undisturbed shall be shown in sufficient detail to be accurately marked on the land.

8. Computation of the total surface water runoff before, during and after the disturbance of land and/or construction of impervious surfaces.

9. Proposed measures for surface water management.

10. A schedule of the sequence of installation of the surface water management structures, stipulating current maintenance, continued maintenance and responsibility for same.

11. Proposed maintenance schedule for all surface water management structures, stipulating current maintenance, continued maintenance and responsibility for same.

12. All proposed revisions of required data as well as such additional data as the planning board may require.

ARTICLE VI

REVIEW AND APPROVAL

Surface water management plans shall be reviewed by the planning board with the advice and assistance of the municipal engineer, the soil conservation district and the environmental commission. The planning board's consideration of applications shall be guided by but not limited to the following factors:

1. The suitability of the applicant's proposed surface water management measures, devices and planning techniques, whether involving on-site or off-site measures, or some combination thereof, in respect to the total surface water runoff, velocities and rates of discharge which the applicant's proposed construction or land disturbance may generate.

2. Existing topography, present vegetation and hydrologic soil factors, as shown on map, Hydrologic Soils, USDA Soil Conservation Service ______________ township stormwater management, June 1, 1973, subject to field verification.

3. Ground water recharge and discharge areas, wet soils and seasonal high ground water table as shown on map alluvial, poorly drained and somewhat poorly drained soils, USDA Soil Conservation Service, ______________ township stormwater management study, June 1, 1974 subject to field verification.

4. The design storm.

5. Natural drainage flow and pattern throughout the subwatershed(s) affected by the plan.

6. Land uses in both the immediate vicinity and surrounding drainage region.

7. Any other applicable or relevant environmental and resource protection ordinances, statutes and regulations.

8. Any other factors relevant to the coordinated, adjusted and harmonious development of the site, vicinity, township and region.

If, after considering the above factors, and after consultation with the municipal engineer, soil conservation district and environmental commission the board determines that the proposed land disturbance or construction will generate no surface water runoff that will not be managed in accordance with standards of this ordinance or will be detrimental to the public health, safety and general welfare in light of the paramount interest in the prevention of conditions which may result in surface water runoff damage, the board shall approve the plan and issue the necessary permit.

If, however, after considering the above factors and after consultation with the municipal engineer, soil conservation district and the municipal environmental commission the board determines that the proposed land disturbance or construction will generate surface water runoff which will not be managed in accordance with the standards of this ordinance and which will be detrimental to the public health, safety and general welfare in light of the paramount public interest in the prevention of conditions which may result in surface water runoff damage and environmental degradation, the board shall deny the permit, and shall clearly and concisely state the reasons.

ARTICLE VII

IMPLEMENTATION

A. Limit of Contract - Critical impact areas and other areas to be left undisturbed shall be physically marked with survey stakes or protected with temporary snow fence prior to any land disturbance.

B. Timing - The planning board shall require the construction and/or installation of surface water management improvements in accordance with the schedule of sequence of installation as approved.

C. Bonding - The planning board shall provide for the posting of performance guarantees and maintenance bonds in the same manner as provided in the subdivision ordinance of ______________ Township.

D. Inspection - The applicant shall bear full and final responsibility for the installation and construction of all required surface water runoff control measures according to the provisions of his approved plan and this ordinance. The municipal engineer shall inspect the site during its preparation and development and certify that all surface water management measures have been constructed in accordance with the provisions of the applicant's approved plan under this ordinance.

During the twelve months subsequent to the date of completion the engineer periodically shall inspect the site to ascertain that the provisions of the applicant's approved plan are complied with, including limit of contract for areas to be left undisturbed. The engineer shall give the applicant upon request a certificate indicating the date on which the required measures were completed and/or accepted.

E. Maintenance - At the time of approval of the plan, responsibility for continued maintenance of surface water runoff control structures and measures shall be stipulated and properly recorded.

The township shall retain the right to enter and make repairs and improvements where necessary to insure that all control measures as well as areas dedicated to surface water retention or groundwater recharge are adequately maintained and preserved. The township may charge the owner for the costs of these services if such maintenance is his responsibility.

PENALTY

A. Any person violating any of the provisions of this ordinance shall, upon conviction thereof,

B. Continued violation

C. Injunctive relief - Nothing in this ordinance shall be construed as to precent the township from seeking injunctive proceedings to restrain violations of any provision of this ordinance.

APPEALS

Appeals from decisions under this ordinance may be made to the minicipal governing body in writing within ten days from the date of such decision. The appellant shall be entitled to a hearing before the municipal governming body within thirty days from date of appeal.

VALIDITY AND SEVERABILITY

If any part of this ordinance is found not valid, the remainder of this ordinance shall remain in effect. All ordinances or parts of ordinances inconsistent with the provisions of this ordinance are hereby repealed to the extent of such inconsistency.

FOOTNOTES

1. Roy F. Weston, Inc., A Manual on Storm Water Management for Evaluating and Mitigating the Effects of Land Use Changes on Runoff.

2. A. Strong, "Regulation of Urban Development to Control Runoff and Erosion."

3. U.S. Environmental Protection Agency, Office of Water Planning and Standards, Washington, D.C., December 1974.

4. S.R. Weibel, R.J. Anderson, and R.C. Woodward, "Urban Land Runoff as a Factor in Stream Pollution," Journal of the Water Pollution Control Federation, Vol. 36, No. 7, July 1964.

5. American Public Works Association, Water Pollution Aspects of Urban Runoff, Federal Water Pollution Control Administration, Water Pollution Control Research Series WP-20-15, January 1969.

6. J.D. Sartor and G.B. Boyd, Water Pollution Aspects of Street Surface Contaminants, Envrionmental Protection Agency, Research and Monitoring Environmental Protection Technology Series, EPA-R2-72-081, November 1972.

7. Ibid.

8. Ibid.

9. U.S. Environmental Protection Agency, Water Quality Management Planning for Urban Runoff, p. V-11 (referred to hereafter as EPA, Urban Runoff).

10. Ibid., V-12.

11. The ability of trout to survive in a stream is often used as a measurement of water quality. Trout require 5 mg/l of oxygen to survive, and can tolerate 3 mg/l for a short period. Obviously, if oxygen levels stay at 5 mg/l for 364 days a year, but drop to 2 mg/l for 1 day because of a heavy pollutant load, there will be no trout in the stream.

12. Strong, op.cit.

13. Ibid.

14. J. Tourbier and R. Westmacott, *Water Resources Protection Measures in Land Development - A Handbook*, Delaware University, Newark, Water Resources Center, April 1974. NTIS: PB-236-049. This report is one of the most thorough and valuable available on the subject of practical measures of erosion and sedimentation control, and is highly recommended for community use.

15. Edward Selig, "Regulatory Dimensions of Nonpoint Source Control," March 1976.

16. *Ibid.*

17. Edison Water Quality Laboratory, *Envrionmental Impact of Highway Deicing*, EPA, Water Quality Office, Water Pollution Control Research Series 11040 GKK, June 1971.

18. *Ibid.*

19. *Ibid.*

20. *Ibid.*

21. *Ibid.*

22. *Ibid.*

23. Tourbier, et al., *op.cit.*, p. 149.

24. Edison Water Quality Laboratory, *op. cit.*

25. Tourbier, et al., *op.cit.*

26. McKee found that in Boston a mild drizzle (.01 inch per hour) will cause combined sewer overflows. With a rain of 0.1 inch perhour, 73 percent of the sanitary wastewater would overflow, even with a treatment system designed to handle three times that average dry-weather flow. McKee, J.E., "Loss of Sanitary Sewage Through Storm Water Overflow," *Jounral Boston Society of Civil Engineers*, 34, No.2, p. 55, 1947.

27. Metcalf and Eddy, Inc. *Urban Stormwater Management and Technology, an Assessment*, prepared for the Environmental Protection Agency, National Environmental Research Center, December 1974. (Referred to hereafter as *Urban Stormwater*.)

28. *Ibid.*, p. 88.

29. *Ibid.*, p. 75.

30. *Ibid.*, p. 67.

31. National Commission of Water Quality, *Draft Final Report*, 1975.

32. Urban Stormwater, p. 147. In addition to the loadings of pollutants carried by the separate stormwater flows, the frequency of discharges in a separated system must be considered. A separate stormwater outfall produces far more frequent discharges than a combined system does, since flows between 1.5 and 3 times the dry-weather flow can usually be handled by the interceptors and the treatment plant.

33. Ibid., p. 149.

34. Ibid., p. 75. Based on observation of 28 overflows of a large combined sewer in Milwaukee, Wisconsin, during 1969. Quality comparisons between the first flush flow and extended flows for these observations are shown in Table V-3.

35. Although some older systems, such as Boston's, were originally built with machinery for flushing the pipes, the capability has seldom if ever been used. Flushing of sediments has generally been restricted to small lateral lines. Cost figures presented here are taken from "A Flushing System for Combined Sewer Cleansing," FMC Corp., 11020 DNO. EPA, March, 1972.

36. Ibid., p. 168.

37. Ibid., p. 168.

38. Ibid., p. 198.

39. Selig, op. cit.

SECTION VI

NOISE CONTROL ORDINANCES

ENVIRONMENTAL IMPACTS OF NOISE

Noise is an important environmental problem in urban areas, and one which has traditionally been the responsibility of local governments. Fireworks, soundtrucks, and other similar noise sources have often been required to have permits, or evey simply banned to keep the community quiet. Even zoning owes much of its early success to the idea that it would separate the noisy industries from the quiet residential areas.

In recent years, though, it has been realized that noise is not just bothersome, but can have an impact on the health and welfare of the community. Attempts have been made to quantify that impact, and to try to control noise and reduce its damage.

The most obvious impact of noise is hearing loss. Exposure to very loud noise sources can cause pain and physical damage to the ears and temporary or permanent loss of hearing. More importantly, though, long-term exposure to somewhat quieter sources can have the same effect. Restlessness, loss of sleep, inability to understand speech, and other interference in people's activities can be caused by even lower levels of noise.[1]

These long-term effects are shown in Table 32. The unit $L_{eq}(24)$ is the yearly average sound energy, as measured in decibles.[2] For hearing loss, it is necessary to be exposed above the level given, on the average, for several years. The L_{dn} measure is similar, but provides a penalty for night noise of 10 dB because of interference with sleeping in sensitive residential areas.[3]

The psychologic effects of various short-term noise types are quite well understood. The levels which cause pain or immediate hearing loss or damage are known. Below these levels, sources concentrated at a single frequency are less desirable than sources spread over the frequency band--a tone is more bothersome than a roar. Warbling or pulsing tones are even more bothersome, and should be penalized in noise standards. (See Table 33)

In general, the long-period standards can be set fairly easily, and there is only a small range of reasonable levels for setting the short-term standards which should be done with consideration of community conditions.

Figure 13 shows one of the welfare effects of noise, relating the average noise level to the percentage of the population annoyed by it.[7] Below about 50 dB, there is essentially no community reaction. At 75 dB, on the other hand, approximately twenty percent of the community is likely to call complaints in to

Table 32

Yearly Average* Equivalent Sound Levels Identified as Requisite to Protect the Public Health and Welfare With An Adequate Margin of Safety[4]

	Measure	Indoor Activity Interference	Indoor Hearing Loss Consideration	Indoor To Protect Against Both Effects (b)	Outdoor Activity Interference	Outdoor Hearing Loss Consideration	Outdoor To Protect Against Both Effects (b)
Residential with Outside Space and Farm Residences	L_{dn}	45		45	55		55
	$L_{eq(24)}$		70			70	
Residential with No Outside Space	L_{dn}	45		45			
	$L_{eq(24)}$		70				
Commercial	$L_{eq(24)}$	(a)	70	70(c)	(a)	70	70(c)
Inside Transportation	$L_{eq(24)}$	(a)	70	(a)			
Industrial	$L_{eq(24)}$(d)	(a)	70	70(c)	(a)	70	70(c)
Hospitals	L_{dn}	45		45	55		55
	$L_{eq(24)}$		70			70	
Educational	$L_{eq(24)}$	45		45	55		55
	$L_{eq(24)}$(d)		70			70	
Recreational Areas	$L_{eq(24)}$	(a)	70	70(c)	(a)	70	70(c)
Farm Land and General Unpopulated Land	$L_{eq(24)}$				(a)	70	70(c)

CODE:

a. Since different types of activities appear to be associated with different levels, identification of a maximum level for activity interference may be difficult except in those circumstances where speech communication is a critical activity.

b. Based on lowest level.

c. Based only on hearing loss.

d. An L_{eq}(8) of 75 dB may be identified in these situations so long as the exposure over the remaining 16 hours per day is dow enough to result in a negligible contribution to the 24-hour average, i.e., no greater than an L_{eq} of 60 dB.

NOTE: Explanation of identified level for hearing loss: the exposure period which results in hearing loss at the identified level is a period of 40 years.

*Refers to energy rather than arithmetic averages.

SOURCE: Office of Noise Abatement and Control, EPA, Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, Washington: EPA, 1974.

Table 33

Continuous Sound Levels Which Pose An Immediate Threat to Health and Welfare (Measured at 50 Feet or 15 Meters)*5

Sound Level Limit (dBA)	Duration
90	24 hours
93	12 hours
96	6 hours
99	3 hours
102	1.5 hours
105	45 minutes
108	22 minutes

*Use equal energy time-intensity trade-off if level varies; find energy equivalent over 24 hours.

Impulsive Sound Levels Which Pose An an Immediate Threat to Health and Welfare (Measured at 50 Feet or 15 Meters)

Sound Level Limit (dBA)	Number of Repetitions per 24 hour Period
145	1
135	10
125	100

Maximum Noise Levels that Allow Communication with 95% Intelligibility (dBA)6

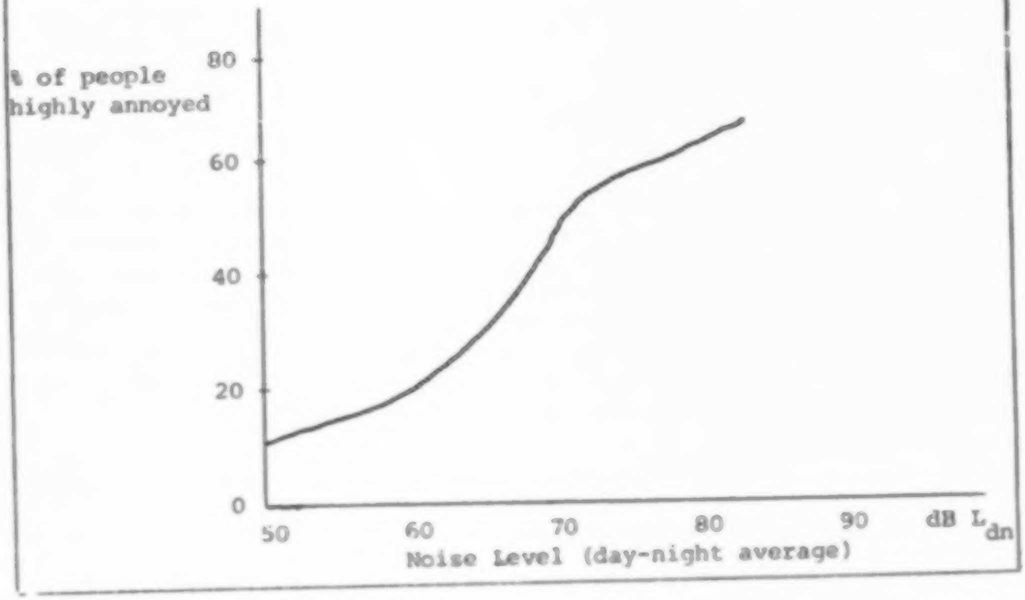
	Communication Distance (meters)					
	.5	1	2	3	4	5
Normal Voice	72	66	60	56	54	52
Raised Voice	78	72	66	62	60	58

SOURCE: Office of Noise Abatement and Control, EPA, Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare With an Adequate Margin of Safety, Washington, EPA, 1974.

the police or noise control officer. The level of noise which people will accept is, of course, conditioned on the amounts they are used to, so this table will vary somewhat from place to place. The shape, though, will stay about the same--there will be some baseline level at which few people will be bothered, a fairly rapid rise until most people are annoyed, and then a slower rise until everyone complains.

Figure 13

Annoyance from Noise



EPA is developing a Community Noise Ordinance Workbook which should be available in 1976, and which will expand the Model Noise Control Ordinance (see Appendix VI-1) and discuss the various standards and options in detail.[8] The publication should be extremely valuable to communities considering noise control programs. Most issues mentioned in this report are discussed in detail in that publication.

TYPES OF NOISE CONTROL

Basic Ordinances

Most urban communities have some sort of noise ordinance, making it illegal to create noises which are a nuisance or which disturb the community. This is not sufficient to control noise pollution. Subjective standards are easily ruled inconsistent and arbitrary, particularly when enforced on major industries or other continuing noise sources.

Thus, objective standards are required which limit the levels of noise affecting others. The easiest method is to set standards related to noise levels by zoning class, and measured at the property line. Thus, the Smiths could not operate an air conditioner which caused noise levels of 60 dBA or more at the Jone's property line. More important, the steel plant in the bordering industrial zone would have similar noise level restrictions on its operations.

These standards can be tested using simple maximum sound level meters, although further equipment is desirable for continuing enforcement. The next section discusses equipment further. Figure 14 shows some examples of what noise levels communities set as their criteria.[9]

Sound and Vibration magazine publishes a yearly review of community noise control ordinances.[10] For 1975, they received information from 539 municipalities, with results shown in Table 34. Since the listing is voluntary, it is most likely to receive contributions from communities with active noise control programs; the listings in the table may not be representative of all communities.

Even so, many communities use only traditional subjective nuisance ordinances, which are weak in court prosecutions. Actual measurements are most common for property line regulations of noise levels in different zoning districts. The control of noise through zoning and the use of objective criteria and instruments for such cases cannot be recommended too strongly--they are the key to a successful noise control program. Vehicle noise, construction and new building standards, and time-averaging standards may improve noise control, but zoning-related controls and objective criteria are the first necessary step.

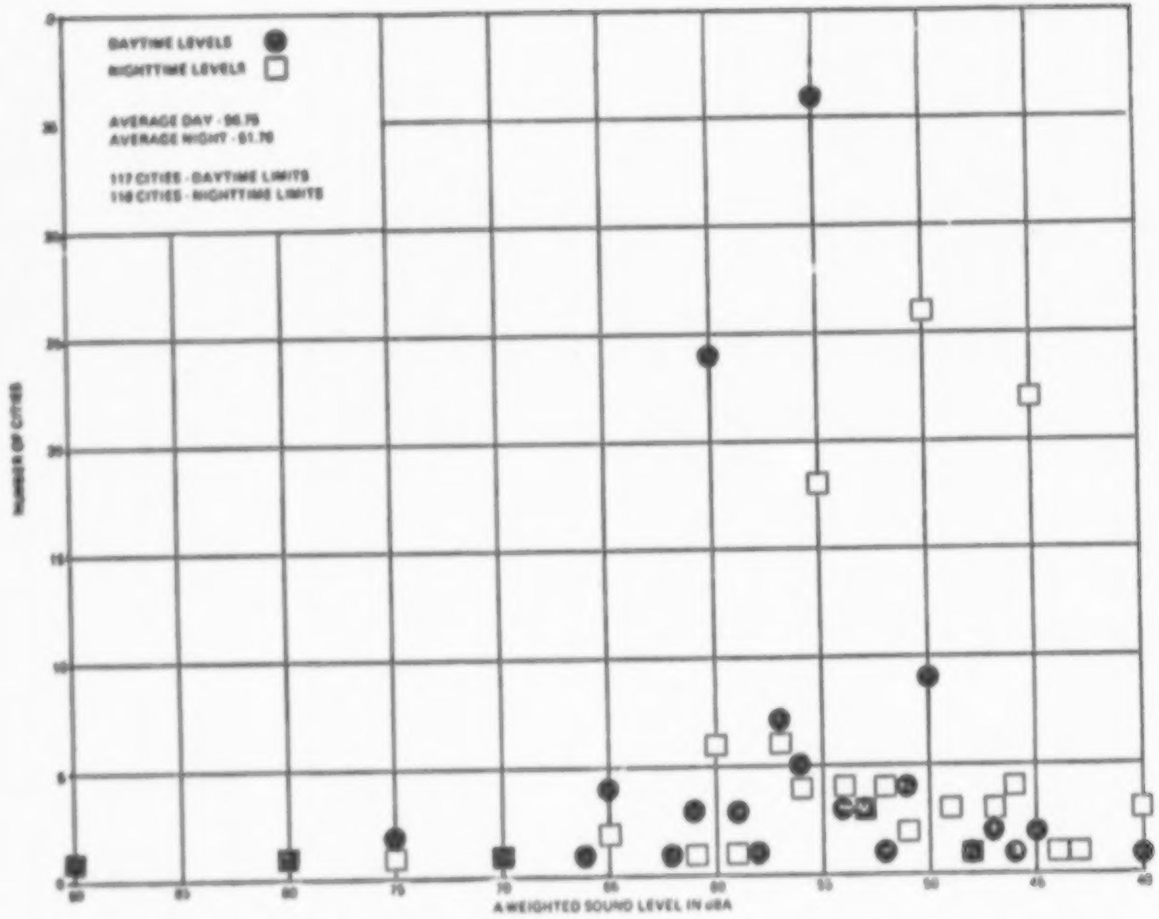
Table 34[11]

1975 Review of Community Noise Control Ordinances

	Percent of Communities with Ordinance Related To:				
	Nuisance	Zoning	Vehicles	Construction	Building
Regulation includes accoustical criteria	113	188	117	42	22
Regulation does not include accoustical criteria	359	18	93	55	8
No Regulation	67	333	329	442	509

Figure 14

Fixed Source Noise Levels Allowable at Residential District Boundaries



SOURCE: EPA, Model Community Noise Control Ordinance.

Time-Averaging Standards

Table 33 provides information on standards for continuous exposure for a forty-year period. For short periods, of course, higher levels of noise can be tolerated: noise damage is dependent on both the intensity of the noise and on its duration, and sources which are loud and continuous may cause more damage than some which are even louder, but brief. Ordinances specifying only maximum sound levels are only partial responses to the complex problems of community noise control.

It is desirable to provide for some sort of time-averaging in the standards. The main focus of initial noise control should be on those sources which are continuing long term problems, and this is easiest with time-averaging controls.

There are several reasons for this focus. First, it is easiest to enforce standards on sources that can be monitored over a long period, as compared to those that are intermittent. By the time an enforcement officer reaches a construction site, the offending equipment may be shut down. Continuing sources are easier to measure, and therefore, more amenable to regulation. A second reason is that continuing sources of noise are more important from a health standpoint. Quieting a noisy party or construction site may make a difference for a few days or weeks, but quieting a factory will reduce noise levels for as long as the factory remains in operation. Thus, the focus on continuing sources is related both to the expected benefits, and to the ease of enforcement.

Once the continuing sources are well-monitored and meet standards, it will be important to broaden the noise control effort to reduce noise from the more difficult and less important short-term noise sources. For most communities, though, noise control resources can be allocated best by implementing time-averaging standards and monitoring the major continuing sources which have the largest long-term effects on the public health and welfare. Short-term nuisances can be controlled, where necessary, using standard nuisance provisions of the noise ordinance.

Measurement of time-averaging standards is more difficult, and requires more expensive equipment and more inspection time. Time-averaging meters are readily available, and will compute the average sound energy levels for however long they are in place. Without such meters, it is necessary to take readings on peak meters, perhaps every five minutes for an hour, to get sufficient information for the averaging process. In communities greatly concerned about noise control, however, the time-averaging approach appears more desirable for control of major sources.

The problem with the pure averaging approach is that there is no control on peak sources. A company could set off an explosion once per hour, and still be within standards if it was otherwise quiet. There are two reasonable solutions to this: either implement a set of peak standards with the time-averaging ones, or combine the two.

The way to combine the two is by the "cumulative distribution" method. Over any period, the amount of noise varies, and the major interest is how often it is above certain levels. The variation can be recorded, and it is then fairly easy to compute the levels which are exceeded ninety percent of the time and ten percent of the time, for example. In many ways this is equivalent to the peak and average measurement, but it may be preferred in some cases.[11]

Motor Vehicle Controls

A number of communities have provides standards for new motor vehicles, recreational vehicles, or other types of equipment sold or used within their jurisdiction. Some measurements of the actual levels of noise from private automobiles are shown in Table 35. Such measurements are made at a fixed distance from the vehicle, usually fifty feet, but it may be desirable to allow closer measurement for places where that is impossible.

Table 35

Caltrans Measurements of Automobile Noise[13]

	Percent of Cars with Noise Greater than Limit				
Speed Limit	85dBA	80dBA	76dBA	75dBA	72dBA
<35 mph	0	.06%	.3%	.7%	3.3%
>35 mph	.04%	1.6%	14.0%	-	-

For trucks, EPA suggests noise standards of 88 dBA for stationary use with a full engine load (for example, a power take-off), 86 dBA for thirty-five mile per hour or slower zones, and 90 dBA for higher speed zones, all measured at fifty feet. These standards will be set for interstate carriers, and the local government cannot set other standards, either stricter or looser.[14] If communities object to these standards, provision of special sound-isolated truck routes may be possible. While the federal government has pre-empted the control of noise from interstate carriers, it has not pre-empted the related land use controls: truck routes are allowed, given EPA approval, and buffer zones around load terminals may also be possible to implement.[15] However, truck routes must be approved by EPA if their principal purpose is to control noise, and not to increase safety, protect pavement, or for some other reason.

Controls on vehicles other than trucks may be set as desired by communities. However, controls on the sale of unusually noisy automobiles are unlikely to be effective, except perhaps in major cities. Most communities should concentrate on the use of motor vehicles, and on insuring that they meet reasonable maintenance and operation standards. This may be particularly important for recreational vehicles, which generally operate in otherwise quiet areas.

Interior Noise in New Construction

The time-averaging standards provided in Table VI-2 are most significant when considered in relation to existing land uses. If construction is planned near an existing noise source, the new buildings should be required to provide sufficient insulation to reduce the noise to a reasonable level (for residential buildings, 45 dB L_{dn}). The new users move into the area in full knowledge of the source, and it should be their responsibility to control for its impacts, to a large degree. Thus, construction should not be allowed in areas where existing exterior noise levels are too high.

California has implemented this idea for new construction near transportation facilities such as highways, railroads, and airports.[16] New construction is required to be designed for 45 db CNEL[17] for residential buildings, and acoustical analysis is required for sites within the 60 dB footprint of transportation facilities. When necessary, inspection may be required before occupancy is allowed (see Appendix VI-3). Because of the performance requirements, the developer of a site in a noise zone is required to bear the costs of insulation and other improvements to meet standards.

The difficulty here is that communities vary widely in their interpretation of what constitutes tolerable levels of interior noise, and what land uses are compatible near major noise sources. Exterior noise cannot be escaped totally: it does little good to construct expensive soundproofing that is defeated each time a door or window is opened. Certain land uses, however, are more tolerant of noise than others. Office buildings, for example, are occupied during the day when tolerance of noise is highest. Offices or commercial sites may also be sealed during the day, though this depends on energy use and climate control system efficiency. In sum, interior noise standards for industrial and commercial buildings may well be higher than those for schools and residences, but certain land uses might be excluded from noisy areas on the basis of ambient exterior noise alone.

Construction

Construction noise is an important problem in urban areas, where construction of a high-rise may take years, and where nearby residents receive all the impacts. On federally-funded projects, an environmental impact statement (EIS) may be required, which would consider the noise effects of construction, but this may not result in reduced noise levels

Construction requires heavy equipment, which is often noisy. Some communities have required that contractors use quieter alternatives to standard equipment--for example, quiet pavement cutters instead of pneumatic hammers. This is important, and should be a policy for local government construction and maintenance. If a construction site is generally quiet, with only a few periods where standards are exceeded, then a time-averaging measurement may be best. Where construction is concerned, some level of nuisance must often be tolerated if buildings are to be built at reasonable cost.

A large number of books, articles, and handbooks have been written about noise insulation. In general, though, insulation used to control heat will also reduce noise transmission, and vice versa. Thus, the suggestions for structure insulation and for storm windows, weatherstripping, and so forth, given in Section III will also reduce noise.

There are materials designed primarily to reduce noise, from simple acoustic tiles to much more exotic supplies. For residential applications, false acoustic ceilings may be valuable, and the use of drapes or rugs to deaden noise may help, but more expensive abatement is generally not cost effective.

As with heat insulation, it is much less expensive to add noise insulation to new structures than to retrofit old buildings, primarily because the same equipment must be used. Retrofitting will be expensive, and should only be done when necessary, for example for schools or public buildings in airport exposure areas.

The use of landscaping and site planning to reduce noise is another option for new development. Highway noise can be greatly reduced by providing barrier hills or groves of trees between the highway and the buildings, for example. Several manuals are available on using such designs to reduce transportation noise; they may be of interest either to transportation planners or to developers considering sites near major noise sources.[18]

Nuisances

One of the biggest community noise problems is the control of "nuisance" noise. In most communities the police have been responsible for controlling sources such as barking dogs, loud parties, and public disturbances. These sources are almost impossible to measure with sound level meters because they vary quickly; nuisance noises are also far more disturbing psychologically than their pure sould level would indicate. Since disturbance noises must be measured subjectively, they are difficult to define in court.

However, it is possible to limit the hours during which certain types of sources can operate. For example, musical instruments, loudspeakers, construction, and loading, may not be allowed in residential areas in the evening and at night. The wording in the EPA ordinance is "between the hours of __:__ pm and __:__ am the following day, such that the sound therefrom creates a noise disturbance across a residential real property boundary or within a noise sensitive zone."[19] (the community should fill in the critical times)

Citizen suits related to nuisance noises are also an important means of controlling noise disturbances. While it may be impossible for the police to gather data about loud parties, the neighbors can, and should be able, to sue if the disturbance is great enough. This is also the only way they can recover damages. However, the suits should be based on the community standards as set forth in the ordinances, to insure consistency.

EFFECTIVENESS AND COST OF NOISE CONTROLS

Problems in Defining Effectiveness of Controls

One EPA survey[20] listed the percent of communities citing various problem noise sources; some of its data is listed in Table 36. Noise from surface transportation, particularly from trucks and motorcycles, was listed most often as a problem. The sample from which the responses were drawn consisted only of communities with active noise control programs; therefore, whether or not the problems cited were those that caused communities to institute control programs, these problems turn out to be the most intractible.

Table 36

Problem Noise Souces

Source	% of Municipalities Citing
Surface Transport	74
Airports	32
Industrial	29
Construction	28
Air Conditioners	27
Dogs	13
Other	30

The most often cited noise problem, by a margin of more than two to one, is surface transportation noise. Within this category lie two general problem areas: the control of chronic traffic noise, and the control of isolated vehicles with defective mufflers or some other offensive noise source (loud tires, honking horns, etc.). In the first case, noise monitoring is of little use: while it definitely reveals and quantifies the problem, enforcement actions are impossible since individual motorists are usually not violating noise standards--the problem is with cumulative effects. In the second case, the violations are so transient that enforcement may be impossible; even if a sound level reading is taken, it may be impossible to identify or catch the offender.

The next most frequently cited problem--airport noise--is equally difficult to control on the community level. Planes operate under federal noise control regulations and cannot be made responsible to any local standard; airports have the freedom to act relatively independent of local community pressure to abate noise, often citing the economic benefits they bring to the locality. Improvements are gained through long term pressure by the community on the airport, and accommodations ultimately reached may not be amicable.

Industrial, construction, and air conditioner noise are cited in the survey with roughly equal frequncy. In these categories, identification, citation, and correction of violations is more straightforward; although some violations are transitory, an effective noise control problem can be designed to measure noise levels accurately, using appropriate combinations of time-averaging and peak sound readings to document offenses. The rate at which these categories appear on the survey may indicate that programs are making headway--fewer citations in these areas might have indicated lack of significant problems; more might have indicated inability to make progress against them.

Interestingly, the "barking dog" and "other" categories in the survey are listed as problems by about one-third of the respondents. These categories subsume most of the general nuisance offenses, and are an important area of community concern. It is not known how many communities have set up noise programs in response to unusual nuisance categories of noise problems, however.

Gauging the effectiveness of any noise program is difficult; while the survey quoted above yields no answers, it does underscore the problem areas. Typically, noise control effectiveness is measured on a case-by-case basis, with success related to the number of violations corrected. This may be true over the short term, where a noise program is being started up. If, however, the number of violations continues to be large, a high rate of enforcement action may actually reveal the failure of the noise program to achieve significant reductions in ambient noise levels. The problem is analogous to crime control--a high arrest rate for felonies can hardly be taken as evidence of a low crime rate.

Several studies[22] have analyzed community noise levels in an attempt to define a meaningful baseline against which to measure progress, but no recognized procedure is available and the cost of comprehensive noise monitoring is high. The best course to follow may be the simplest: perform a noise survey to analyze the extent of standards violations before a new program, and regularly recheck survey sites after enforcement actions. The key is to measure the same problem areas repeatedly; while the results are not comprehensive, they will be useful.

In general, nationwide municipal enforcement of noise ordinances has been low. Of the cities with ordinances responding to the EPA survey, one-eighth of the cities were responsible for eighty-three percent of total enforcement activity.[23] Given the high rate at which such problems as transportation noise were cited, the low rate of enforcement actions on the part of the other seven-eights of communities must be taken as a sign of program failure in the preponderance of cases. Since nationwide data on program success is poor, however, it would be highly valuable for communities undertaking new programs to attempt to quantify the progress of their controls against baseline measurements, and to communicate their results to the EPA.

Implementation and Organization of Noise Control

Noise control has been implemented on its own, and as part of a number of other departments in the local government. Table 37 shows some of the options. From the results, and from other information in the survey which described the activity of the agencies, it was found that those noise control organizations which were in environmental departments or on their own were the most active, and those included with the police department were least active.[26]

Table 37

Responsibility for Noise Control

Public Health	20%
Environmental	18%
Police	23%
Planning	14%
Building	9%
Other	15%

The reasons for this are not clear. The police have a large number of duties, so in some communities noise control may not get sufficient emphasis when included within the police department. On the other hand, it has been traditional to include nuisance noise control functions with the police, and the inactive communities may not have added further functions and may not require a separate department.

In general, though, a noise control organization will be most effective and most credible when it is either part of a general environmental pollution abatement department or, in large enough cities, on its own. EPA suggests that a population of 500,000 is sufficient to support a separate department.[27] For this reason, the Model Ordinance is written for an environmental control department, although it could be modified to define an independent group.

ORDINANCES

The Model Community Noise Control Ordinance, prepared for and published by the EPA, is quite broad in scope and is well drafted. The introduction in the EPA materials provides most of the background needed to instruct a community in the purposes and design of the ordinance, and in the areas of potential modification to meet the community's specific needs. As noted by the EPA drafters, the section of the ordinance dealing with enforcement will be the one most likely in need of revision to make it conform to local practice and law. The Community Noise Ordinance Handbook provides a number of useful options, for enforcement and standards, and should be acquired by any community serious about setting up a noise program.

Special enabling legislation for noise control may be necessary in some instances. EPA and the Council of State Governments have developed a model enabling act for local noise control programs (see Appendix VI-2), coordinated with the powers required in local communities. In most states, however, such special enabling legislation will not be required, because the communities already have the necessary powers. The final draft of this Model state ordinance was written at the Second National Symposium on Environmental Legislation in 1973.[28]

According to the introduction to the act, it

> ...attempts to give the state maximum authority to regulate noise pollution consistent with the preemptive provisions of the Federal Noise Control Act of 1972.

For the purposes of this chapter, Title 3 is the most significant portion. It contains the provisions enabling local governments to produce noise control plans, which include:

1. Noise levels which will not be exceeded in specific zones;

2. Procedures for implementing transportation system plans;

3. Plans concerning land use;

4. Requirements of building designs;

5. Implementation procedures;

6. Strategies for compliance with state and federal regulations; and

7. Noise restrictions for construction activities.

These powers are sufficient to enable local government to adopt an ordinance similar to the EPA model ordinance included in Appendix VI-1.

The California noise insulation ordinance for new construction is given in Appendix VI-3.

Appendix VI-1

EPA 550/9-76-003

MODEL COMMUNITY NOISE CONTROL ORDINANCE

SEPTEMBER 1975

PREPARED BY:

National Institute of Municipal
Law Officers
in conjunction with
The U.S. Environmental Protection Agency

This document has been approved for general availability. It does not constitute a standard, specification, or regulation.

MODEL COMMUNITY NOISE CONTROL ORDINANCE

LIST OF PROVISIONS

CONTENTS

PAGE

ARTICLE I SHORT TITLE 17

ARTICLE II DECLARATION OF FINDINGS AND POLICY; SCOPE 17

ARTICLE III DEFINITIONS AND STANDARDS 17

ARTICLE IV POWERS AND DUTIES OF THE (ENVIRONMENTAL PROTECTION)/(NOISE CONTROL) OFFICE(R) 22

4.1 Lead (Agency/Official) 22
4.2 Powers of the (Environmental Protection)/(Noise Control) Office(r) 22
4.2.1 Studies 22
4.2.2 Education 23
4.2.3 Coordination and Cooperation 23
4.2.4 Review of Actions of Other Departments 23
4.2.5 Review of Public and Private Projects 23
4.2.6 Inspections 23
4.2.7 Records 24
4.2.8 Measurements by the Owner or Operator 24
4.2.9 Product Performance Standard Recommendations 24
4.2.10 Noise Sensitive Zone Recommendations 24
4.3 Duties of (Environmental Protection)/(Noise Control) Office(r) 25
4.3.1 Standards, Testing Methods, and Procedures 25
4.3.2 Investigate and Pursue Violations 25
4.3.3 Delegation of Authority 25
4.3.4 Truck Routes and Transportation Planning 25
4.3.5 Capital Improvement Guidelines 25
4.3.6 State and Federal Laws and Regulations 25
4.3.7 Planning to Achieve Long Term Noise Goals 26
4.3.8 Administer Grants, Funds and Gifts 26
4.3.9 Periodic Report 26

PAGE

ARTICLE V DUTIES AND RESPONSIBILITIES OF OTHER DEPARTMENTS 26
5.1 Departmental Actions 26
5.2 Departmental Cooperation 26
5.3 Departmental Compliance with Other Laws 26
5.4 Project Approval 27
5.5 Contracts 27
5.6 Low Noise Emission Products 27
5.7 Capital Improvement Program 27

ARTICLE VI PROHIBITED ACTS 27
6.1 Noise Disturbances Prohibited 27
6.2 Specific Prohibitions 28
6.2.1 Radios, Television Sets, Musical Instruments and Similar Devices 28
6.2.2 Loudspeakers/Public Address Systems 28
6.2.3 Street Sales 29
6.2.4 Animals and Birds 29
6.2.5 Loading and Unloading 29
6.2.6 Construction 29
6.2.7 Vehicle or Motorboat Repairs and Testing 29
6.2.8 Airport and Aircraft Operations 30
6.2.9 Places of Public Entertainment 30
6.2.10 Explosives, Firearms, and Similar Devices 30
6.2.11 Powered Model Vehicles 30
6.2.12 Vibration 31
6.2.13 Stationary Non-Emergency Signaling Devices 31
6.2.14 Emergency Signaling Devices 31
6.2.15 Motorboats 32
6.2.16 Noise Sensitive Zones 32
6.2.17 Domestic Power Tools 32
6.2.18 Tampering 32

ARTICLE VII EXCEPTIONS AND VARIANCES 33
7.1 Emergency Exception 33
7.2 Special Variances 33
7.3 Variances for Time to Comply 34
7.4 Appeals 35

PAGE

ARTICLE VIII SOUND LEVELS BY RECEIVING LAND USE 36
8.1 Maximum Permissible Sound Levels by Receiving Land Use 36
8.2 Correction for Character of Sound 36
8.3 Exemptions 36

ARTICLE IX MOTOR VEHICLE MAXIMUM SOUND LEVELS 37
9.1 Motor Vehicles and Motorcycles on Public Rights-of-Way 37
9.1.1 Adequate Mufflers or Sound Dissipative Devices 38
9.1.2 Motor Vehicle Horns and Signaling Devices 38
9.1.3 Refuse Collection Vehicles 38
9.1.4 Standing Motor Vehicles 39
9.2 Recreational Motorized Vehicles Operating Off Public Rights-of-Way 39

ARTICLE X LAND USE 40
10.1 General Provisions 40
10.2 Construction Restrictions for Habitable and Institutional Structures 40
10.3 Recreational Area Restrictions 41
10.4 Site Study Requirement 42
10.5 Commercial and Industrial Construction 43
10.6 Sound from New Transportation Systems in Residential Areas 43
10.7 Equivalent Measurement Systems 43
10.8 Zoning Ordinance or Comprehensive Plan 43
10.9 Truth in Selling or Renting 44
10.10 Appeals 44

ARTICLE XI ENFORCEMENT 44
11.1 Penalties 44
11.2 Abatement Orders 44
11.3 Notice of Violation 45
11.4 Immediate Threats to Health and Welfare 45
11.5 Citizen Suits 45
11.6 Other Remedies 48
11.7 Severability 48
11.8 Effective Date 48

TABLES

		PAGE
Table 1.	Sound Levels by Receiving Land Use	36
Table 2.	Motor Vehicle and Motorcycle Sound Limits	37
Table 3.	Recreational Motorized Vehicle Sound Limits	39
Table 4.	Continuous Sound Levels	46
Table 5.	Impulsive Sound Levels	46
Table 6.	Provisions Under Which Civil Actions May Be Commenced	47

PREAMBLE TO THE MODEL COMMUNITY NOISE CONTROL ORDINANCE

INTRODUCTION

Purpose

The Model Community Noise Control Ordinance (model ordinance) is intended to be a basic tool which communities, both large and small, can use to construct noise control ordinances suited to local needs and conditions. The complete model ordinance, including optional provisions, is perhaps most suitable for larger communities, with populations of about 100,000 or more. Smaller communities and large communities with limited resources may wish to adopt only those provisions which address their most pressing noise problems. It is important that the community ensure that all provisions adopted are realistic in relation to local needs and conditions; that all provisions are consistent with one another, with other local law, and with State and Federal law; and, finally, that all provisions are clear and otherwise well drafted so that enforcement problems will be minimized.

Background

This model ordinance is an outgrowth of the Federal Noise Control Act of 1972 (49 U.S.C. §§ 4901 *et seq.*) and the tremendous increase in interest regarding noise abatement and control which the Act has precipitated. Many existing community noise ordinances are based on outmoded model ordinances and/or the common law approach to noise control which relies exclusively on difficult to enforce nuisance provisions. While the model ordinance preserves common law with Article VI provisions prohibiting noise disturbances, it also contains definitive performance standards for motor vehicles and other sources of community noise. The increase in reliable monitoring equipment available to local governments, coupled with definitive standards incorporated into local noise control ordinances, should result in ordinances which are more easily enforceable than many have been in the past.

It is anticipated that an analagous model ordinance will form part of a workbook on community noise abatement and control to be published by the U.S. Environmental Protection Agency during late 1975. In addition to containing the model ordinance (perhaps with discussions of a number of alternative provisions), the workbook may contain chapters on the legal basis of noise control, the health effects of noise and various enforcement approaches.

Although the model ordinance will stand alone as a legal document, for proper enforcement the City/County must additionally have a code of recommended practices or rules and regulations which give general specifications for sound measuring equipment and measurement methodology. This document should also provide detailed procedures for measurements to be taken for certain provisions of the ordinance, such as motor vehicles and stationary sources. To assist communities in the development of a code of recommended practices, EPA is preparing a model code which, when completed, will be sent to recipients of the model ordinance.

Interrelationship of Various Provisions

An overview of the model ordinance can most readily be obtained by reading the List of Provisions. When a community determines which activities it wishes to regulate, the appropriate model provision or provisions can be located by referring to this list.

A glance through the List of Provisions suggests that certain acts may be prohibited by more than one provision. For example, use of a noisy go-cart could violate Section 9.2 ("Recreational Vehicles Operating Off Public Rights-Of-Way"), as well as Section 6.1 (Noise Disturbance). It may be that a community desires such multiple coverage. In this case, enforcement against the owner or operator of a noisy go-cart would probably come under the provision more easily enforced, but could come under both provisions violated, at the discretion of the enforcement agency. If a community does not desire such multiple coverage, it can either omit certain provisions or it can exempt acts covered by other provisions from multiple coverage. Such modifications deserve careful consideration, however, so that they do not modify the ordinance more than desired or otherwise jeopardize enforcement.

GENERAL PROVISIONS

Policy Regarding Levels

In this model ordinance, recommended values for sound levels in the performance standards have been omitted in most cases. Suggested times for the curfews on the hours of the conduct of activities or the operation of equipment have also generally been omitted. The reason for these omissions is that the drafters of the ordinance feel that there is no single number that can be chosen for each provision that would be appropriate for all types of communities. Each community has its own set of environmental, health, economic and other goals it wishes to attain. Each community also has its own configuration of noise sources and their impact which it wishes to control. The level and extent of such control is fully within the purview of local decision. Of course, localities will wish to consider the technical practicality and economic reasonableness of sound levels chosen. However, in the regulation of noise pollution, the protection of public health and welfare is the major legal basis for control and must be carefully considered in the determination of performance standard noise levels and hours of curfew. For a specification of national maximum noise exposure guidelines, consult *Information on the Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety* (U.S. Environment Protection Agency, March 1974).

Preemption

Under the Noise Control Act of 1972 (49 U.S.C. § § 4901 *et seq.*), certain areas of local authority will become preempted on the effective date of regulations developed by the U.S. Environmental Protection Agency pursuant to Sections 6, 17 and 18 of this Act. In this discussion, we will present the scope of Federal preemption and indicate the provisions of the model ordinance which were drafted wholly or partially to respond to the issue of preemption.

An overall requirement to monitor Federal preemptive regulations and to respond to them in the local noise ordinance is contained in Section 4.3.6 (b). This subsection provides that, at such time as Federal regulations become effective which are by law preemptive of the laws of State and local governments, the Environmental Protection Officer(r) Noise Control Office(r) (EPO/NCO) shall review the provisions of the local ordinance which may be affected and make appropriate recommendations for changes to the city council legislative body.

The purposes of including such a provision in this ordinance are to facilitate the coordination of the local noise control efforts with the Federal noise program and to reduce the possibility of defendants raising Federal preemption as a defense to charges of local law violations.

With regard to the scope of preemption, the preemptive provision of Section 6 of the Noise Control Act differs considerably from those of Sections 17 and 18. The Section 6 provision is relatively narrow, preempting local laws covering new product noise emission levels which are directed at the manufacture or sale of such products. The preemptive provisions of Sections 17 and 18 are very broad, preempting local noise laws which affect the operation of interstate motor and rail carrier vehicles.

In Section 6, subsection 6(e)(1) provides that, after the effective date of an EPA regulation prescribing noise emission levels for a specific new product or component, no State or political subdivision thereof may adopt or enforce with respect to that particular new product or component any law or regulation which sets a noise emission limit on such product (or component) enforceable against the manufacturer of the product, applicable at the time of sale, unless such law or regulation is identical to the Federal regulation. Thus, the preemption is against State and local laws which regulate the noise levels of a new product (i.e., a product which has not yet been sold to the first retail purchaser) and which, at any time, impact the manufacturer of the product.

State and local governments, under subsection 6(e)(2), retain authority to control products by all other available means. This subsection states that nothing in this section precludes or denies the right of State or local governments to establish and enforce controls on environmental noise and sources thereof through the licensing, regulation, or restriction of the use, operation, or movement of any product or combination of products.

Thus, although a local government may not enforce a nonidentical local law regarding the noise level of an EPA-regulated new product which affects the manufacture or sale of such product, the local government may regulate the product noise impact through regulations enforceable against the owner or operator of the product by providing, for example, maximum noise levels for operation, curfews on operation, prohibition of use in a residential neighborhood or hospital zone, or requirements for periodic inspection and licensing of the product.

Broader preemptive coverage is found in Sections 17(c)(1) and 18(c)(1). These sections provide that, after the effective date of an EPA regulation applicable to noise emissions from interstate rail or motor carriers, no State or political subdivision thereof may adopt or enforce any standard applicable to the same noise source unless such standard is identical to the Federal standard. However, Sections 17(c)(2) and 18(c)(2) provide that nothing in these sections shall diminish or enhance the right of State and local governments to establish and enforce standards or controls on levels of environmental noise or to control, license, regulate, or restrict the use, operation, or movement of any regulated product if two conditions occur:

1. the EPA Administrator, after consultation with the Secretary of the Department of Transportation, determines that such local law is necessitated by special local conditions, and

2. if he determines that such local law is not in conflict with the EPA regulations.

Thus, on the effective date of the EPA regulations under Section 18 (October 15, 1975) and Section 17 (undetermined as yet), local governments should review any ordinance provisions applicable to noise emissions resulting from the use or operation of motor vehicles with a gross vehicle or combination weight rating of greater than 10,000 lbs. operated by an interstate motor carrier and of interstate surface railroad locomotives and cars. Local regulations providing standards on noise emissions resulting from operations subject to Federal regulations must be identical to the Federal regulation. Such identity applies not only to the standard but also to the core measurement methodology which defines the standard. Non-identical standards may not be enforced, and should be declared ineffective, as of the effective date of the Federal regulation. For this reason, Section 18 standards have been incorporated into Table II of Section 9.1 in the model ordinance. The appropriate measurement methodology should be incorporated into the community code of recommended practices.

In general, we can classify the preemptive effect of these sections on local law into three categories. First, any local law which sets noise emission levels for interstate motor vehicles and rail locomotives and cars must be identical to the Federal standard. No special local condition or other factor can exempt this requirement. Second, local laws which regulate or restrict the use, operation, or movement of interstate motor rail carriers by such means as curfews and truck routes (see Section 4.3.4, Truck Routes and Transportation Planning) will not be subject to preemption if (1) the principal purpose of such regulation is not to control noise, or (2) the principal purpose is to control noise but the regulation has been approved by the EPA as necessitated by special local conditions and not in conflict with Federal regulations. For example, truck routes designated solely on the basis of noise must be submitted to EPA for determination of a special local condition. Truck routes based on additional factors, such as the safety of children, maximum load on street surfaces, etc., will not need EPA approval. Third, general noise regulations, such as the property line noise emission standards of Article VIII, will not be affected by these preemption provisions except in rare cases. Thus, the property line levels may be applied to noise emissions caused by interstate motor carrier vehicles at a loading terminal so long as means of abatement are possible which do not require controlling the noise emission level of the motor vehicle itself. Such other means of abatement can include, for example, installation of noise barriers at the perimeter of the terminal and creation of buffer zones of land between the terminal and the noise-impacted areas.

Hearing Board and Advisory Council

A City/County with a large EPO/NCO may prefer to utilize a Hearing Board (or an administrative court) to hear cases regarding ordinance violations. Under this approach, the Hearing Board would decide the case and determine the penalty. Local courts would be utilized in appeals of the decisions of the board. This approach avoids overburdening existing courts.

The City/County may also wish to use a Hearing Board to make determinations on Special Variances (Section 7.2) and Variances for Time to Comply (Section 7.3). This would free EPO/NCO personnel to perform other tasks under the ordinance. However, the EPO/NCO could still be consulted on technical matters.

If the City/County decides to have a Hearing Board, the terms of existence and operation of the Board should be specified in the ordinance.

A Noise Control Advisory Council should also be considered by the City/County. The functions of this council could include providing (1) advice on development of the noise control program; (2) recommendations on which provisions of the model ordinance should be included in the City/County ordinance; (3) recommendations on sound level values and curfew periods for the various provisions; and (4) stimulation of public interest on noise abatement. This Council could also be responsible for writing the periodic reports, specified in Section 4.3.9, concerning the progress of the local noise control program.

SPECIFIC PROVISIONS

Article III – Definitions

1. Section 3.2.16. *Definition of "Motorboat"*

A community which serves as an international port may wish to explicitly exclude vessels in international commerce from the definition of motorboat, since many such vessels would be effectively prohibited from using the port (under Section 6.2.15, Motorboats).

2. Section 3.2.29. *Definition of "Sound"*

The term "sound" is generally used as the operative word in this ordinance rather than the term "noise". This is to avoid the problem of associating "noise" with a sound that is "disturbing" or "unwanted", with the attendant possibility that in order to prove a violation of the ordinance, proof must be given that the sound had indeed been "disturbing" or "unwanted". Because the substantive provisions of the ordinance have been narrowly drawn and often contain objective criteria, proof of an additional subjective element is unnecessary.

3. Section 3.2.22. *Definition of "Person"*

The definition of person does not include Federal agencies and departments. This is because legal decisions have not yet determined the extent of a locality's authority to bring action against the Federal government for noise control violations.

Reproduced from
best available copy.

Section 4 of the Noise Control Act of 1972 requires that all departments, agencies, and instrumentalities of the executive, legislative, and judicial branches of the Federal Government comply with Federal, State, interstate, and local requirements respecting control and abatement of environmental noise to the same extent that any person is subject to such requirements. The Federal Courts of Appeals, deciding cases under identical language in the Clean Air Act, have disagreed as to whether this language extends to administrative as well as substantive requirements. See *State of Alabama v. Seeber*, 502 F. 2d. 1238 (5 Cir. 1974); *Kentucky v. Commonwealth of Kentucky v. Ruckelshaus*, 497 F. 2d 1172 (6 Cir. 1974). *Kentucky v. Ruckelshaus* is pending before the Supreme Court, and a resolution of the issue is likely. Further questions exist as to whether a State or local government can bring an action against the Federal Government for violations of their noise control laws, regulations and ordinances. Accordingly, the key definition of "person" in the model ordinance, which serves as an applicability section, does not include the Federal Government.

In the absence of such specificity, Section 4 of the Noise Control Act continues to require that the Federal Government comply with the local ordinance. However, it is left to each community to determine the position it will take with respect to the relevant issues, such as whether the Federal Government must comply with administrative provisions, and whether penalties, orders, and enforcement actions will be directed at the Federal Government under Article XI (Enforcement).

Article IV – Powers and Duties of the (Environmental Protection) (Noise Control) Office(r)

1. Resolving Interdepartmental Conflicts

Section 4.2.4 (Review of Actions of Other Departments); Section 4.2.5 (Review of Public and Private Projects), Section 4.3.4 (Truck Routes and Transportation Planning) and Article V (Duties and Responsibilities of other Departments) have the potential of causing interdepartmental conflicts since there is shared responsibility. The community may wish to specify in the ordinance a method for resolving such conflicts, perhaps by authorizing the city council, county board of supervisors, mayor, etc., to negotiate differences and make a final decision.

2. Education

Section 4.2.2 authorizes the (Environmental Protection) (Noise Control) Office(r) to educate the public on methods of controlling noise and on the provisions of the ordinance. The EPO may wish to exercise caution, however, in providing specific advice on solving a particular noise problem. For instance, if the EPO were to advise a commercial establishment on a method of reducing noise from its air conditioning unit and this method failed to be effective, the commercial establishment may try to use this fact as a defense in any action brought against it by the EPO. The EPO officer should use his discretion in handling matters of this type.

3. Review of Public and Private Projects

Section 4.2.5 grants the EPO the power to review public and private projects over which another department has authority in order to determine whether they will comply with the ordinance. This applies to such matters as licensing a race track, approving a housing project, or granting a permit for a construction site, if required to be approved by a department other than that of the EPO/NCO and if likely to create sound levels or sound exposures in violation of the ordinance.

Some communities may wish to expand this section to authorize the EPO to recommend to other departments appropriate modifications to projects if the EPO believes such projects will violate the ordinance or to allow him veto power over projects significantly impacting the noise environment.

This provision does not set criteria for determining whether a proposed project must be reviewed by the EPO/NCO. If the City/County wishes the EPO/NCO to review every proposed project, such criteria are not necessary, but this policy may create an unnecessarily large burden on the EPO/NCO. If the City/County wishes to limit situations where the proposed project is subject to noise impact review, criteria can be either included in the language of this provision, or the EPO/NCO can develop criteria in consultation with affected departments. Such criteria may include, for example, minimum monetary or time limits for the review of activities or specification of the types of activities which are likely to produce sound in violation of the ordinance.

4. Inspections

Section 4.2.6 concerns inspections. To be constitutionally permissible, administrative searches or inspections conducted by municipal inspectors on private property must be made using a warrant procedure (*Camara v. Municipal Court*, 387 U.S. 523 (1967); *See v. Seattle*, 387 U.S. 541 (1967)). Thus, if a private property holder refuses to allow his premises to be inspected by a City/County official, the official must obtain a search warrant for the premises before he may inspect them. The Court in *See* also held that there is no distinction between the rights of a residential property holder and those of a commercial property holder concerning searches or inspections. Both types of property are thus treated the same in Section 4.2 et al.

Violations of Article VIII (Noise Levels by Receiving Land Use) and most Article VI (Prohibited Acts) violations can be determined without an inspection on the premises on which the sound source is situated, so a search warrant is not needed in these situations.

Article VIII – Sound Levels by Receiving Land Use (Defining Land Use Districts)

Article VIII sets property line sound limits for the broad receiving land use categories of residential, commercial and industrial. Many communities are employing this type of quantitative limit to provide stronger legal control over undesirable sound levels than is attainable with an ordinance containing only nuisance provisions.

If the community land use/zoning code accurately reflects the actual use of the land, then the designations used by the city for zoning categories may effectively be plugged into the three Article VIII categories (with the corresponding definitions placed in Article III). On the other hand, if there are numerous discrepancies between the way the land is zoned and the way it is actually used (e.g., commercial establishments in a residential zone), or if there are large tracts of unzoned land, the community may prefer to base property line limits on the actual *use* of the land. This would provide greater protection for impacted properties.

A related matter to be considered in controlling property line noise is that of the occasional non-conforming land use. An example is the case of a single residence located in an industrial area. It may not be possible for several manufacturers impacting the residence to lower their noise levels to meet the limit specified for residential areas. Situations of this type will require some discretion in enforcement.

Figures 1, 2, and 3 summarize graphically the property line levels set by current municipal noise ordinances.

Article X – Land Use

The basic purpose of the Article X land use planning provisions is to ensure that no new residences, institutions or recreational areas are constructed in high noise areas, as determined by the appropriate sections. Although the Article was drafted to stand independently from the existing community land use planning or zoning systems, it is important for a community considering enactment of this Article to study the interaction of Article X with the land use planning and/or zoning laws and to reconcile them where necessary. It may be better, for example, to enact Article X as an amendment to an existing land use law rather than as a part of the noise control ordinance. Furthermore, because this Article effectively rezones land subject to its provisions, the community may want or need to take special measures before enactment of this Article. These may include a general identification of the areas that will be affected by these provisions.

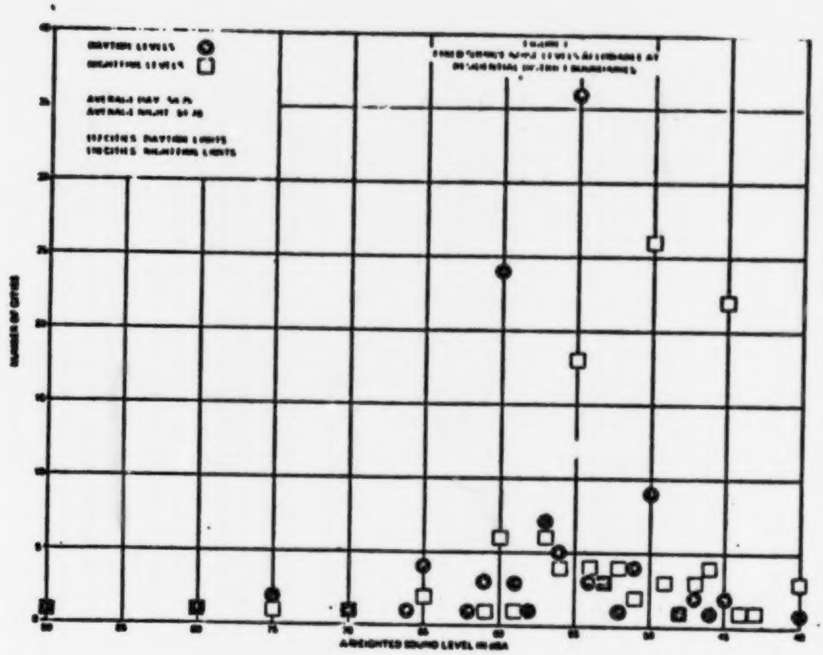


Figure 1. Fixed Source Noise Levels Allowable at Residential District Boundaries

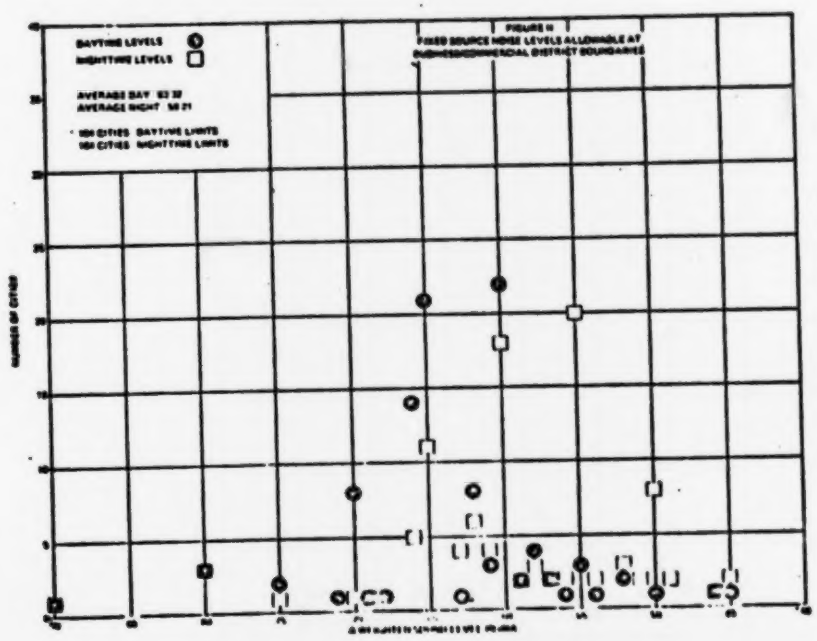


Figure 2. Fixed Source Noise Levels Allowable at Business/Commercial District Boundaries

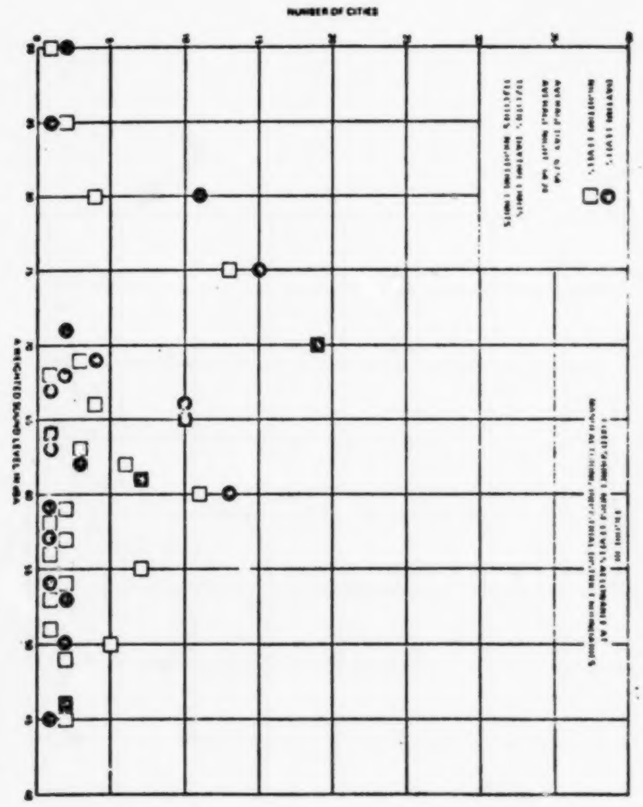


Figure 3. Fixed Source Noise Levels Allowable at Manufacturing/Industrial District Boundaries

Article XI – Enforcement

Provisions in this Article are more likely to need revision to conform with local law than other provisions of the model ordinance. For example, the City County may wish to make violations of the ordinance "infractions," similar to minor traffic violations, rather than misdemeanors, due to the stigma attached to such violations.

The City/County may wish to ensure that the public is reasonably well-informed of activities prohibited by the ordinance before fully effectuating its enforcement program. For example, the City/County may utilize a discretionary policy of issuing an abatement order for a first violation, followed by a citation for the original violation, if the abatement order is not complied with. This approach is provided for in Section 11.2 (Abatement Orders) and would be used for violations that are presumed to be unintentional. The EPO NCO may wish to establish guidelines for use of the abatement order, indicating, for example, appropriate types of violations for which an order may be issued and maximum time period of an order.

The enforcement scheme contained in this ordinance also includes a provision for citizen suits (Section 11.5). The advantage of the citizen suit approach is that many violations of the ordinance which the EPO/NCO has insufficient resources to prosecute can be legally dealt with by persons affected by the violation. Provisions under which one citizen can sue another are limited to those listed in Table VI, to minimize the possibility of "harassment" suits.

Section 11.3 (Notice of Violation) is incomplete in several respects for easy adaptation to the local law of the particular City/County.

Section 11.4 (Immediate Threats to Health and Welfare) provides the EPO NCO with the authority to force immediate abatement of sources producing sound intensities that not only violate the ordinance but are also unquestionably harmful to the health of the public exposed to them. The sound levels regulated (see Tables IV and V) are deliberately set high, because there is no procedure in this provision for balancing public health with economic or other considerations; public health is the sole determinant. The health and welfare criterion for the levels set is a temporary threshold shift of 30 dB at 4 kHz.

Subsection (b) limits the applicability of this provision to impacts on members of the general public who are involuntarily exposed to the sound. Employee exposures at their workplace are exempted because employee sound exposure levels are regulated under the Occupational Safety and Health Act (29 U.S.C. §§ 669 *et seq.* (1970)).

Severe sanctions for noncompliance with the order are provided for in subsection (d), so that the sound will not continue to be a detriment to public health. If the order is unjustified, a court can invalidate or suspend it soon after the order is issued, in a mandamus type proceeding. This remedy is contained in subsection (c), which may need to be modified to conform with local procedure.

Under Section 11.6 (Other Remedies), common law and statutory remedies previously used to regulate excessive sound will still remain available. It is desirable to retain such remedies to allow private persons the possibility of recovering damages or other remedies for the effects of excessive sound since private recovery is not provided for under the ordinance. The ordinance is intended to expand existing sound control law, not to limit it.

FORMAT

In reading the model ordinance it is essential that certain typographical symbols and format be understood. Several brief rules have been followed in drafting. These are:

1. The material contained in square brackets [ ] is optional, depending on the needs and conditions of a given community. (Of course, communities developing ordinances may decide that any given provision should be deleted.)

2. Parentheses ( ) are generally used to designate alternative choices, but in some cases contain explanatory information, depending on the context.

3. Blanks ___ must be filled in by the community with appropriate information.

4. Wherever the term EPO NCO appears, the title of the community's lead noise enforcement agency or official should be inserted.

Reproduced from
best available copy.

MODEL COMMUNITY NOISE CONTROL ORDINANCE

MODEL COMMUNITY NOISE CONTROL ORDINANCE

ARTICLE I SHORT TITLE

This ordinance may be cited as the "Noise Control Ordinance of the (City/County) of ________."

ARTICLE II DECLARATION OF FINDINGS AND POLICY; SCOPE

2.1 DECLARATION OF FINDINGS AND POLICY

WHEREAS excessive sound and vibration are a serious hazard to the public health and welfare, safety, and the quality of life; and WHEREAS a substantial body of science and technology exists by which excessive sound and vibration may be substantially abated; and, WHEREAS the people have a right to and should be ensured an environment free from excessive sound and vibration that may jeopardize their health or welfare or safety or degrade the quality of life; and, NOW, THEREFORE, it is the policy of the (City/County) of ________ to prevent excessive sound and vibration which may jeopardize the health and welfare or safety of its citizens or degrade the quality of life.

2.2 SCOPE

This ordinance shall apply to the control of all sound and vibration originating within the limits of the (City/County) of ________.

ARTICLE III DEFINITIONS

3.1 TERMINOLOGY

All terminology used in this ordinance, not defined below, shall be in conformance with applicable publications of the American National Standards Institute (ANSI) or its successor body.

3.2.1 "A-WEIGHTED SOUND LEVEL" MEANS

The sound pressure level in decibels as measured on a sound level meter using the A-weighting network. The level so read is designated dB(A) or dBA.

3.2.2 "COMMERCIAL AREA" MEANS

((As defined in the community (comprehensive plan)/(zoning ordinance)).

3.2.3 "CONSTRUCTION" MEANS

Any site preparation, assembly, erection, substantial repair, alteration, or similar action, but excluding demolition, for or of public or private rights-of-way, structures, utilities or similar property.

3.2.4 "DAY-NIGHT AVERAGE SOUND LEVEL (L_{dn})" MEANS

The 24-hour energy average of the A-weighted sound pressure level, with the levels during the period 10:00 p.m. to 7:00 a.m. the following day increased by 10 dBA before averaging.

3.2.5 "DECIBEL (dB)" MEANS

A unit for measuring the volume of a sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure, which is 20 micropascals (20 micronewtons per square meter).

3.2.6 "DEMOLITION" MEANS

Any dismantling, intentional destruction or removal of structures, utilities, public or private right-of-way surfaces, or similar property.

3.2.7 "EMERGENCY" MEANS

Any occurrence or set of circumstances involving actual or imminent physical trauma or property damage which demands immediate action.

3.2.8 "EMERGENCY WORK" MEANS

Any work performed for the purpose of preventing or alleviating the physical trauma or property damage threatened or caused by an emergency.

3.2.9 "ENVIRONMENTAL PROTECTION OFFICE(R)/NOISE CONTROL OFFICE(R) (EPO/NCO)" MEANS

The municipal agency or department having lead responsibility for this ordinance. (If no such agency is designated, the term shall mean the municipal official having lead responsibility for this ordinance.)

3.2.10 **"EQUIVALENT A-WEIGHTED SOUND LEVEL (L_{eq})" MEANS**

The constant sound level that, in a given situation and time period, conveys the same sound energy as the actual time-varying A-weighted sound. [For the purposes of this ordinance, a time period of 24 hours shall be used, unless otherwise specified.]

3.2.11 "GROSS VEHICLE WEIGHT RATING (GVWR)" MEANS

The value specified by the manufacturer as the recommended maximum loaded weight of a single motor vehicle. In cases where trailers and tractors are separable, the gross combination weight rating (GCWR), which is the value specified by the manufacturer as the recommended maximum loaded weight of the combination vehicle, shall be used.

3.2.12 "IMPULSIVE SOUND" MEANS

Sound of short duration, usually less than one second, with an abrupt onset and rapid decay. Examples of sources of impulsive sound include explosions, drop forge impacts, and the discharge of firearms.

3.2.13 "INDUSTRIAL AREA" MEANS

((As defined in the community (comprehensive plan)/(zoning ordinance)).

3.2.14 "MOTOR CARRIER VEHICLE ENGAGED IN INTERSTATE COMMERCE" MEANS

Any vehicle for which regulations apply pursuant to Section 18 of the Federal Noise Control Act of 1972 (P.L. 92-574), as amended, pertaining to motor carriers engaged in interstate commerce.

3.2.15 "MOTOR VEHICLE" MEANS

(As defined in the motor vehicle code of the State)/(Any vehicle which is propelled or drawn on land by a motor, such as, but not limited to, passenger cars, trucks, truck-trailers, semi-trailers, campers, go-carts, snowmobiles, amphibious craft on land, dune buggies, or racing vehicles, but not including motorcycles.)

3.2.16 "MOTORBOAT" MEANS

Any vessel which operates on water and which is propelled by a motor, including, but not limited to, boats, barges, amphibious craft, water ski towing devices and hover craft.

3.2.17 **"MOTORCYCLE" MEANS**

(As defined in the motor vehicle code of the State)/(An unenclosed motor vehicle having a saddle for the use of the operator and two or three wheels in contact with the ground, including, but not limited to, motor scooters and minibikes.)

3.2.18 "MUFFLER OR SOUND DISSIPATIVE DEVICE" MEANS

A device for abating the sound of escaping gases of an internal combustion engine.

3.2.19 "NOISE" MEANS

Any sound which annoys or disturbs humans or which causes or tends to cause an adverse psychological or physiological effect on humans.

3.2.20 "NOISE DISTURBANCE" MEANS

Any sound which (a) endangers or injures the safety or health of humans or animals, or (b) annoys or disturbs a reasonable person of normal sensitivities, or (c) endangers or injures personal or real property.

3.2.21 "NOISE SENSITIVE ZONE" MEANS

Any area designated pursuant to Section 4.2.10 of this ordinance for the purpose of ensuring exceptional quiet.

3.2.22 "PERSON" MEANS

Any individual, association, partnership, or corporation, and includes any officer, employee, department, agency or instrumentality of a State or any political subdivision of a State.

3.2.23 "POWERED MODEL VEHICLE" MEANS

Any self-propelled airborne, waterborne, or landborne plane, vessel, or vehicle, which is not designed to carry persons, including, but not limited to, any model airplane, boat, car, or rocket.

3.2.24 "PUBLIC RIGHT-OF-WAY" MEANS

Any street, avenue, boulevard, highway, sidewalk or alley or similar place which is owned or controlled by a governmental entity.

3.2.25 "PUBLIC SPACE" MEANS

Any real property or structures thereon which are owned or controlled by a governmental entity.

3.2.26 "PURE TONE" MEANS

Any sound which can be distinctly heard as a single pitch or a set of single pitches. For the purposes of this ordinance, a pure tone shall exist if the one-third octave band sound pressure level in the band with the tone exceeds the arithmetic average of the sound pressure levels of the two contiguous one-third octave bands by 5 dB for center frequencies of 500 Hz and above and by 8 dB for center frequencies between 160 and 400 Hz and by 15 dB for center frequencies less than or equal to 125 Hz.

3.2.27 "REAL PROPERTY BOUNDARY" MEANS

An imaginary line along the ground surface, and its vertical extension, which separates the real property owned by one person from that owned by another person, but not including intra-building real property divisions.

3.2.28 "RESIDENTIAL AREA" MEANS

((As defined in the community (comprehensive plan)/(zoning ordinance)).

3.2.29 "RMS SOUND PRESSURE" MEANS

The square root of the time averaged square of the sound pressure, denoted P_{rms}.

3.2.30 "SOUND" MEANS

An oscillation in pressure, particle displacement, particle velocity or other physical parameter, in a medium with internal forces that causes compression and rarefaction of that medium. The description of sound may include any characteristic of such sound, including duration, intensity and frequency.

3.2.31 "SOUND LEVEL" MEANS

The weighted sound pressure level obtained by the use of a sound level meter and frequency weighting network, such as A, B, or C as specified in American National Standards Institute specifications for sound level meters (ANSI S1.4 - 1971, or the latest approved revision thereof). If the frequency weighting employed is not indicated, the A-weighting shall apply.

3.2.32 "SOUND LEVEL METER" MEANS

An instrument which includes a microphone, amplifier, RMS detector, integrator or time averager, output meter, and weighting networks used to measure sound pressure levels.

3.2.33 "SOUND PRESSURE" MEANS

The instantaneous difference between the actual pressure and the average or barometric pressure at a given point in space, as produced by sound energy.

3.2.34 "SOUND PRESSURE LEVEL" MEANS

20 times the logarithm to the base 10 of the ratio of the RMS sound pressure to the reference pressure of 20 micropascals (20×10^{-6} N m^{-2}). The sound pressure level is denoted L_p or SPL and is expressed in decibels.

3.2.35 "VIBRATION" MEANS

An oscillatory motion of solid bodies of deterministic or random nature described by displacement, velocity, or acceleration with respect to a given reference point.

3.2.36 "WEEKDAY" MEANS

Any day Monday through Friday which is not a legal holiday.

ARTICLE IV POWERS AND DUTIES OF THE (ENVIRONMENTAL PROTECTION)/(NOISE CONTROL) OFFICE(R)

4.1 LEAD (AGENCY/OFFICIAL)

The noise control program established by this ordinance shall be administered by (title of municipal agency or lead official).

4.2 POWERS OF THE (ENVIRONMENTAL PROTECTION)/(NOISE CONTROL) OFFICE(R)

In order to implement and enforce this ordinance and for the general purpose of sound and vibration abatement and control, the EPO/NCO shall have, in addition to any other authority vested in it, the power to:

4.2.1 STUDIES

Conduct, or cause to be conducted, research, monitoring, and other studies related to sound and vibration.

4.2.2 EDUCATION

(a) Conduct programs of public education regarding:

  (1) The causes, effects and general methods of abatement and control of noise and vibration;

  (2) The actions prohibited by this ordinance and the procedures for reporting violations;

(b) Encourage the participation of public interest groups in related public information efforts.

4.2.3 COORDINATION AND COOPERATION

(a) Coordinate the noise and vibration control activities of all municipal departments;

(b) Cooperate to the extent practicable with all appropriate State and Federal agencies;

(c) Cooperate or combine to the extent practicable with appropriate county and municipal agencies;

(d) Enter into contracts [with the approval of the (appropriate authority)] for the provision of technical and enforcement services.

4.2.4 REVIEW OF ACTIONS OF OTHER DEPARTMENTS

Request any other department or agency responsible for any proposed or final standard, regulation or similar action to consult on the advisability of revising the action, if there is reason to believe that the action is not consistent with this ordinance.

4.2.5 REVIEW OF PUBLIC AND PRIVATE PROJECTS

Review public and private projects, subject to mandatory review or approval by other departments, for compliance with this ordinance, if such projects are likely to cause sound or vibration in violation of this ordinance.

4.2.6 INSPECTIONS

(a) Upon presentation of proper credentials, enter and inspect any private property or place, and inspect any report or records at any reasonable time when granted permission by the owner, or by some other person with apparent authority to act for the owner. When permission is refused or cannot be obtained, a search warrant may be obtained from a court of competent jurisdiction upon showing of probable cause to believe that a violation of this ordinance may exist. Such inspection may include administration of any necessary tests.

[(b) Stop any motor vehicle, motorcycle, or motorboat operated on a public right-of-way, public space, or public waterway reasonably suspected of violating any provision of this ordinance, and issue a notice of violation or abatement order which may require the motor vehicle, motorcycle or motorboat to be inspected or tested as the EPO/NCO may reasonably require.]

4.2.7 RECORDS

Require the owner or operator of any commercial or industrial activity to establish and maintain records and make such reports as the EPO/NCO may reasonably prescribe.

4.2.8 MEASUREMENTS BY THE OWNER OR OPERATOR

Require the owner or operator of any commercial or industrial activity to measure the sound level of or the vibration from any source in accordance with the methods and procedures and at such locations and times as the EPO/NCO may reasonably prescribe and to furnish reports of the results of such measurements to the EPO/NCO. The EPO/NCO may require the measurements to be conducted in the presence of its enforcement officials.

4.2.9 PRODUCT PERFORMANCE STANDARD RECOMMENDATIONS

(a) Develop and recommend for promulgation (to the appropriate authority) provisions regulating the use and operation of any product, including the specification of maximum allowable sound emission levels of such product.

[(b) Develop and recommend for promulgation (to the appropriate authority) provisions prohibiting the sale of products which do not meet specified sound emission levels, where the sound level of the product is not regulated by the United States Environmental Protection Agency under Section 6 of the Noise Control Act of 1972.]

4.2.10 NOISE SENSITIVE ZONE RECOMMENDATIONS

Prepare recommendations, to be approved by (the appropriate authority), for the designation of noise sensitive zones which contain noise sensitive activities. Existing quiet zones shall be considered noise sensitive zones until otherwise designated. Noise sensitive activities include, but are not limited to, operations of schools, libraries open to the public, churches, hospitals, and nursing homes.

4.3 DUTIES OF (ENVIRONMENTAL PROTECTION)/(NOISE CONTROL) OFFICE(R)

In order to implement and enforce this ordinance effectively, the EPO/NCO shall within a reasonable time after the effective date of the ordinance:

4.3.1 STANDARDS, TESTING METHODS, AND PROCEDURES

Develop, [recommend to the appropriate authority,] and promulgate standards, testing methods and procedures.

4.3.2 INVESTIGATE AND PURSUE VIOLATIONS

In consonance with Section 4.2.6, Article XI, and other provisions of this ordinance, investigate and pursue possible violations of this ordinance.

4.3.3 DELEGATION OF AUTHORITY

Delegate functions, where appropriate under this ordinance, to personnel within the EPO/NCO and to other agencies or departments, [subject to approval of ___________].

4.3.4 TRUCK ROUTES AND TRANSPORTATION PLANNING

(a) Study the existing transportation systems, such as truck routes within the community; determine areas with sensitivity to sound and vibration caused by transportation; recommend changes or modifications to transportation systems to minimize the sound and vibration impact on residential areas and noise sensitive zones.

(b) Assist in or review the total transportation planning of the community, including planning for new roads and highways, bus routes, airports, and other systems for public transportation, to ensure that the impact of sound and vibration receives adequate consideration.

4.3.5 CAPITAL IMPROVEMENT GUIDELINES

Establish noise assessment guidelines for the evaluation of proposed improvements for the capital improvements budget and program pursuant to Section 5.5. These guidelines shall assist in the determination of the relative priority of each improvement in terms of noise impact.

4.3.6 STATE AND FEDERAL LAWS AND REGULATIONS

(a) Prepare and publish [with the approval of ___________] a list of those products manufactured to meet specified noise emission limits under Federal, State, or community law for which "tampering" enforcement will be conducted;

(b) Make recommendations for modifications or amendments to this ordinance to ensure consistency with all State and Federal laws and regulations.

[4.3.7] PLANNING TO ACHIEVE LONG TERM NOISE GOALS

[Develop a generalized sound level map of the (city/county), a long term plan for achieving quiet in the (city/county), and [with the approval of ___________ ,] integrate this plan into the planning process of the (city/county).]

4.3.8 ADMINISTER GRANTS, FUNDS AND GIFTS

Administer noise program grants and other funds and gifts from public and private sources, including the State and Federal governments.

[4.3.9] PERIODIC REPORT

[Evaluate and report, every _____ year(s) following the effective date of this ordinance, on the effectiveness of the (city/county) noise control program and make recommendations for any legislative or budgetary changes necessary to improve the program. This report shall be made to the (Noise Control Advisory Board)/(appropriate authority) which may amend it after consultation with the EPO/NCO, and then submit it to the (appropriate authority), for approval.]

ARTICLE V DUTIES AND RESPONSIBILITIES OF OTHER DEPARTMENTS

5.1 DEPARTMENTAL ACTIONS

All departments and agencies shall, to the fullest extent consistent with other law, carry out their programs in such a manner as to further the policy of this ordinance.

5.2 DEPARTMENTAL COOPERATION

All departments and agencies shall cooperate with the EPO/NCO to the fullest extent in enforcing this ordinance.

5.3 DEPARTMENTAL COMPLIANCE WITH OTHER LAWS

All departments and agencies shall comply with Federal and State laws and regulations and the provisions and intent of this ordinance respecting the control and abatement of noise to the same extent that any person is subject to such laws and regulations.

5.4 PROJECT APPROVAL

All departments whose duty it is to review and approve new projects or changes to existing projects, that result, or may result, in the production of sound or vibration shall consult with the EPO/NCO prior to any such approval.

5.5 CONTRACTS

Any written contract, agreement, purchase order, or other instrument whereby the (city/county) is committed to the expenditure of ______ dollars or more in return for goods or services shall contain provisions requiring compliance with this ordinance.

5.6 LOW NOISE EMISSION PRODUCTS

Any product which has been certified by the Administrator of the United States Environmental Protection Agency pursuant to Section 15 of the Noise Control Act as a low noise emission product and which he determines is suitable for use as a substitute, shall be procured by the city/county and used in preference to any other product, provided that such certified product is reasonably available and has a procurement cost which is not more than (125) percentum of the least expensive type of product for which it is certified as a substitute.

5.7 CAPITAL IMPROVEMENT PROGRAM

All departments responsible for a capital improvements budget and program shall prepare an analysis of the noise impact of any proposed improvements in accordance with noise assessment guidelines established by the EPO/NCO pursuant to Section 4.3.5. Proposed capital improvements include land acquisition, building construction, highway improvements, and utilities and fixed equipment installation.

ARTICLE VI PROHIBITED ACTS

6.1 NOISE DISTURBANCES PROHIBITED

No person shall unreasonably make, continue, or cause to be made or continued, any noise disturbance. Non commercial public speaking and public assembly activities conducted on any public space or public right-of-way shall be exempt from the operation of this Section.

6.2 SPECIFIC PROHIBITIONS

The following acts, and the causing thereof, are declared to be in violation of this ordinance:

6.2.1 RADIOS, TELEVISION SETS, MUSICAL INSTRUMENTS AND SIMILAR DEVICES

Operating, playing or permitting the operation or playing of any radio, television, phonograph, drum, musical instrument, sound amplifier, or similar device which produces, reproduces, or amplifies sound:

(a) Between the hours of ______ p.m. and ______ a.m. the following day in such a manner as to create a noise disturbance across a real property boundary or within a noise sensitive zone. [except for activities open to the public and for which a permit has been issued by (appropriate authority) according to criteria set forth in ____________];

(b) In such a manner as to create a noise disturbance at 50 feet (15 meters) from such device, when operated in or on a motor vehicle on a public right-of-way or public space, or in a boat on public waters;

(c) In such a manner as to create a noise disturbance to any person other than the operator of the device, when operated by any passenger on a common carrier;

(d) This section shall not apply to non-commercial spoken language covered under Section 6.2.2.

6.2.2 LOUDSPEAKERS/PUBLIC ADDRESS SYSTEMS

(a) Using or operating for any noncommercial purpose any loudspeaker, public address system, or similar device between the hours of 10:00 p.m. and 8:00 a.m. the following day, such that the sound therefrom creates a noise disturbance across a residential real property boundary or within a noise sensitive zone.

(b) Using or operating for any commercial purpose any loudspeaker, public address system, or similar device (1) such that the sound therefrom creates a noise disturbance across a real property boundary or within a noise sensitive zone; or (2) between the hours of ______ p.m. and ______ a.m. the following day on a public right-of-way or public space.

6.2.3 STREET SALES

Offering for sale or selling anything by shouting or outcry within any residential or commercial area of the (city/county) [except by permit issued by (appropriate authority) according to criteria set forth in ________ and/or except between the hours of _____ a.m. and _____p.m.].

6.2.4 ANIMALS AND BIRDS

Owning, possessing or harboring any animal or bird which frequently or for continued duration, howls, barks, meows, squawks, or makes other sounds which create a noise disturbance across a residential real property boundary or within a noise sensitive zone. [This provision shall not apply to public zoos.]

6.2.5 LOADING AND UNLOADING

Loading, unloading, opening, closing or other handling of boxes, crates, containers, building materials, garbage cans, or similar objects between the hours of _____ p.m. and _____a.m. the following day in such a manner as to cause a noise disturbance across a residential real property boundary or within a noise sensitive zone.

6.2.6 CONSTRUCTION

Operating or permitting the operation of any tools or equipment used in construction, drilling, or demolition work:

(a) Between the hours of _____p.m. and _____a.m. the following day on weekdays or at any time on (Sundays/weekends) or holidays, such that the sound therefrom creates a noise disturbance across a residential real property boundary or within a noise sensitive zone, except for emergency work of public service utilities or by special variance issued pursuant to Section 7.2;

(b) At any other time such that the sound level at or across a real property boundary exceeds an L_{eq} of _____dBA for the daily period of operation..

(c) This section shall not apply to the use of domestic power tools subject to Section 6.2.17.

6.2.7 VEHICLE OR MOTORBOAT REPAIRS AND TESTING

Repairing, rebuilding, modifying, or testing any motor vehicle, motorcycle, or motorboat in such a manner as to cause a noise disturbance across a residential real property boundary or within a noise sensitive zone.

6.2.8 AIRPORT AND AIRCRAFT OPERATIONS

(a) The EPO/NCO shall consult with the airport proprietor to recommend changes in airport operations to minimize any noise disturbance which the airport owner may have authority to control in its capacity as proprietor.

(b) Nothing in this section shall be construed to prohibit, restrict, penalize, enjoin, or in any manner regulate the movement of aircraft which are in all respects conducted in accordance with, or pursuant to, applicable Federal laws or regulations.

6.2.9 PLACES OF PUBLIC ENTERTAINMENT

Operating, playing, or permitting the operation or playing of any radio, television, phonograph, drum, musical instrument, sound amplifier, or similar device which produces, reproduces, or amplifies sound in any place of public entertainment at a sound level greater than _____dBA as read by the slow response on a sound level meter at any point that is normally occupied by a customer, unless a conspicuous and legible sign is located outside such place, near each public entrance, stating "WARNING: SOUND LEVELS WITHIN MAY CAUSE PERMANENT HEARING IMPAIRMENT."

6.2.10 EXPLOSIVES, FIREARMS, AND SIMILAR DEVICES

The use or firing of explosives, firearms, or similar devices which create impulsive sound so as to cause a noise disturbance across a real property boundary or on a public space or right-of-way, without first obtaining a special variance issued pursuant to Section 7.2. [Such permit need not be obtained for licensed game-hunting activities on property where such activities are authorized.]

6.2.11 POWERED MODEL VEHICLES

Operating or permitting the operation of powered model vehicles so as to create a noise disturbance across a residential real property boundary, in a public space or within a noise sensitive zone between the hours of _____p.m. and _____ a.m. the following day. Maximum sound levels in a public space during the permitted period of operation shall conform to those set forth for residential land use in Table 1 of Section 8.1 and shall be measured at a distance of _____feet (meters) from any point on the path of the vehicle. Maximum sound levels for residential property and noise sensitive zones, during the permitted period of operation, shall be governed by Section 8.1 and Section 6.2.16, respectively.

6.2.12 VIBRATION

Operating or permitting the operation of any device that creates vibration which is above the vibration perception threshold of an individual at or beyond the property boundary of the source if on private property or at ______ feet (meters) from the source if on a public space or public right-of-way. For the purposes of this section, "vibration perception threshold" means the minimum ground - or structure – borne vibrational motion necessary to cause a normal person to be aware of the vibration by such direct means as, but not limited to, sensation by touch or visual observation of moving objects.

6.2.13 STATIONARY NON-EMERGENCY SIGNALING DEVICES

(a) Sounding or permitting the sounding of any [electronically-amplified] signal from any stationary bell, chime, siren, whistle or similar device, intended primarily for nonemergency purposes, from any place, [for more than ______minutes in any hourly period.]

[(b) Devices used in conjunction with places of religious worship shall be exempt from the operation of this provision.]

[(c) Sound sources covered by this provision and not exempted under subsection (b) shall be exempted by (appropriate authority) using criteria set forth in Section 7.2.]

6.2.14 EMERGENCY SIGNALING DEVICES

(a) The intentional sounding or permitting the sounding outdoors of any fire, burglar, or civil defense alarm, siren, whistle or similar stationary emergency signaling device, except for emergency purposes or for testing, as provided in subsection (b).

(b) (i) Testing of a stationary emergency signaling device shall occur at the same time of day each time such a test is performed, but not before ______ a.m. or after ______ p.m. Any such testing shall use only the minimum cycle test time. In no case shall such test time exceed ______ seconds.

(ii) Testing of the complete emergency signaling [illegible], including the functioning of the signaling de[illegible]rsonnel response to the signaling device, shall not occur more than once in each calendar month. Such testing shall not occur before ______a.m. or after ______p.m. The time limit specified in subsection (i) shall not apply to such complete system testing.

[(c) Sounding or permitting the sounding of any exterior burglar [or fire] alarm or any motor vehicle burglar alarm unless such alarm is automatically terminated within ______ minutes of activation. [This section shall not be interpreted to apply to ____________ alarms.]

6.2.15 MOTORBOATS

Operating or permitting the operation of any motorboat in any lake, river, stream, or other waterway in such a manner as to exceed a sound level of ______ dBA at 50 feet (15 meters) or the nearest shoreline, whichever distance is less.

6.2.16 NOISE SENSITIVE ZONES

(a) Creating or causing the creation of any sound within any noise sensitive zone designated pursuant to Section 4.2.10, so as to disrupt the activities normally conducted within the zone, provided that conspicuous signs are displayed indicating the presence of the zone; or

(b) Creating or causing the creation of any sound within any noise sensitive zone, designated pursuant to Section 4.2.10, containing a hospital, nursing home, or similar activity, so as to interfere with the functions of such activity or disturb or annoy the patients in the activity, provided that conspicuous signs are displayed indicating the presence of the zone.

6.2.17 DOMESTIC POWER TOOLS

Operating or permitting the operation of any mechanically powered saw, drill, sander, grinder, lawn or garden tool, snowblower, or similar device used outdoors in residential areas between the hours of ______ p.m. and ______a.m. the following day so as to cause a noise disturbance across a residential real property boundary.

6.2.18 TAMPERING

The following acts or the causing thereof are prohibited:

(a) The removal or rendering inoperative by any person other than for purposes of maintenance, repair, or replacement, of any noise control device or element of design or noise label of any product identified under Section 4.3.6. The EPO/NCO may, by regulation, list those acts which constitute violation of this provision.

[(b) The (intentional) removing or rendering inaccurate or inoperative of any sound monitoring instrument or device positioned by or for the EPO/NCO, provided such device or the immediate area is clearly labeled, in accordance with EPO/NCO regulations, to warn of the potential illegality.]

(c) The use of a product, identified under Section 4.3.6, which has had a noise control device or element of design or noise label removed or rendered inoperative, with knowledge that such action has occurred.

ARTICLE VII EXCEPTIONS AND VARIANCES

7.1 EMERGENCY EXCEPTION

The provisions of this ordinance shall not apply to (a) the emission of sound for the purpose of alerting persons to the existence of an emergency, or (b) the emission of sound in the performance of emergency work.

7.2 SPECIAL VARIANCES

(a) The (EPO/NCO)/(Hearing Board) shall have the authority, consistent with this section, to grant special variances which may be requested pursuant to Sections 6.2.6 (Construction) and 6.2.10 (Explosives, Firearms, and Similar Devices).

(b) Any person seeking a special variance pursuant to this section shall file an application with the (EPO/NCO)/(Hearing Board). The application shall contain information which demonstrates that bringing the source of sound or activity for which the special variance is sought into compliance with this ordinance would constitute an unreasonable hardship on the applicant, on the community, or on other persons. [Notice of an application for a special variance shall be published according to (jurisdictional procedure).] Any individual who claims to be adversely affected by allowance of the special variance may file a statement with the (EPO/NCO)/(Hearing Board) containing any information to support his claim. If the (EPO/NCO)/(Hearing Board) finds that a sufficient controversy exists regarding an application, a public hearing may be held.

(c) In determining whether to grant or deny the application, the (EPO/NCO)/(Hearing Board) shall balance the hardship to the applicant, the community, and other persons of not granting the special variance against the adverse impact on the health, safety, and welfare of persons

affected, the adverse impact on property affected, and any other adverse impacts of granting the special variance. Applicants for special variances and persons contesting special variances may be required to submit any information the (EPO/NCO)/(Hearing Board) may reasonably require. In granting or denying an application, the (EPO/NCO)/(Hearing Board) shall place on public file a copy of the decision and the reasons for denying or granting the special variance.

(d) Special variances shall be granted by notice to the applicant containing all necessary conditions, including a time limit on the permitted activity. The special variance shall not become effective until all conditions are agreed to by the applicant. Noncompliance with any condition of the special variance shall terminate it and subject the person holding it to those provisions of this ordinance regulating the source of sound or activity for which the special variance was granted.

(e) Application for extension of time limits specified in special variances or for modification of other substantial conditions shall be treated like applications for initial special variances under subsection (b).

(f) The (EPO/NCO)/(Hearing Board) may issue guidelines [approved by __________] defining the procedures to be followed in applying for a special variance and the criteria to be considered in deciding whether to grant a special variance.

7.3 VARIANCES FOR TIME TO COMPLY

(a) Within ______days following the effective date of this ordinance, the owner of any commercial or industrial source of sound may apply to the (EPO/NCO)/(Hearing Board) for a variance in time to comply with Section 6.2.12 (Vibration) or Article VIII. The (EPO/NCO)/(Hearing Board) shall have the authority, consistent with this section, to grant a variance, not to exceed ______days from the effective date of this ordinance.

(b) Any person seeking a variance in time to comply shall file an application with the (EPO/NCO)/(Hearing Board). The application shall contain information which demonstrates that bringing the source of sound or activity for which the variance is sought into compliance with this ordinance prior to the date requested in the application would constitute an unreasonable hardship on the applicant, on the community, or on other persons. [Notice of an application for a variance in time to comply shall be published according to (jurisdictional procedure).] Any individual who claims to be adversely affected by allowance of the variance in time to comply may file a statement with the (EPO/

NCO)/(Hearing Board) containing any information to support his claim. If the (EPO/NCO)/(Hearing Board) finds that a sufficient controversy exists regarding an application, a public hearing may be held.

(c) In determining whether to grant or deny the application, the (EPO/NCO)/(Hearing Board) shall balance the hardship to the applicant, the community, and other persons of not granting the variance in time to comply against the adverse impact on health, safety, and welfare of persons affected, the adverse impact on property affected, and any other adverse impacts of granting the variance. Applicants for variances in time to comply and persons contesting variances may be required to submit any information the (EPO/NCO)/(Hearing Board) may reasonably require. In granting or denying an application, the (EPO/NCO)/(Hearing Board) shall place on public file a copy of the decision and the reasons for denying or granting the variance in time to comply.

(d) Variances in time to comply shall be granted to the applicant containing all necessary conditions, including a schedule for achieving compliance. The variance in time to comply shall not become effective until all conditions are agreed to by the applicant. Noncompliance with any condition of the variance shall terminate the variance and subject the person holding it to those provisions of this ordinance for which the variance was granted.

(e) Application for extension of time limits specified in variances in time to comply or for modification of other substantial conditions shall be treated like applications for initial variances under subsection (b), except that the (EPO/NCO)/(Hearing Board) must find that the need for the extension or modification clearly outweighs any adverse impacts of granting the extension or modification.

(f) The (EPO/NCO)/(Hearing Board) may issue guidelines [approved by ____________] defining the procedures to be followed in applying for a variance in time to comply and the criteria to be considered in deciding whether to grant a variance.

7.4 APPEALS

Appeals of an adverse decision of the (EPO/NCO)/(Hearing Board) shall be made to the (appropriate court of law). Review of the court shall be (*de novo*)/(limited to whether the decision is supported by substantial evidence)/(as specified by the ________________).

ARTICLE VIII SOUND LEVELS BY RECEIVING LAND USE

8.1 MAXIMUM PERMISSIBLE SOUND LEVELS BY RECEIVING LAND USE

No person shall operate or cause to be operated on private property any source of sound in such a manner as to create a sound level which exceeds the limits set forth for the receiving land use category in Table 1 when measured at or within the property boundary of the receiving land use.

Table 1. Sound Levels by Receiving Land Use

Receiving land-use category	Time	Sound level limit, dBA
R-1, R-2, etc.	(A) a.m. – (B) p.m.	L_1
(Residential, public space, open space, agricultural or institutional)	(B) p.m. – (A) a.m.	L_2
C-1, C-2, etc. B-1, B-2, etc. (Commercial or business)	At all times	L_3
M-1, M-2, etc. (Industrial)	At all times	L_4

8.2 CORRECTION FOR CHARACTER OF SOUND

For any source of sound which emits a pure tone or impulsive sound, the maximum sound level limits set forth in Section 8.1 shall be reduced by _____ dBA.

8.3 EXEMPTIONS

The provisions of this article shall not apply to:

(a) Activities covered by the following Sections: 6.2.6 (Construction), 6.2.8 (Aircraft and Airport Operations), 6.2.10 (Explosives, Firearms, and Similar Devices), 6.2.13 (Stationary Nonemergency

Signaling Devices), 6.2.14 (Emergency Signaling Devices), 6.2.15 (Motorboats), 6.2.17 (Domestic Power Tools), 9.1.3 (Refuse Collection Vehicles), 9.2 (Recreational Motorized Vehicles Operating Off Public Rights-of-Way);

(b) The unamplified human voice;

(c) Interstate railway locomotives and cars; and

[(d) (Non-stationary farming equipment)/(all agricultural activities)]

ARTICLE IX MOTOR VEHICLE MAXIMUM SOUND LEVELS

9.1 MOTOR VEHICLES AND MOTORCYCLES ON PUBLIC RIGHTS-OF-WAY

No person shall operate or cause to be operated a public or private motor vehicle or motorcycle on a public right-of-way at any time in such a manner that the sound level emitted by the motor vehicle or motorcycle exceeds the level set forth in Table 2.

Table 2. Motor Vehicle and Motorcycle Sound Limits
(Measured at 50 Feet or 15 Meters)

Vehicle class	Sound level in dBA		
	Speed limit 35 MPH or less	Speed limit over 35 MPH	Stationary run-up
Motor carrier vehicle engaged in interstate commerce of GVWR or GCWR of 10,000 lbs. or more	86	90	88
All other motor vehicles of GVWR or GCWR of 10,000 lbs. or more	A	B	–
Any motorcycle	C	D	–
Any other motor vehicle or any combination of vehicles towed by any motor vehicle	E	F	–

9.1.1 ADEQUATE MUFFLERS OR SOUND DISSIPATIVE DEVICES

(a) No person shall operate or cause to be operated any motor vehicle or motorcycle not equipped with a muffler or other sound dissipative device in good working order and in constant operation;

(b) No person shall remove or render inoperative, or cause to be removed or rendered inoperative, other than for purposes of maintenance, repair, or replacement, any muffler or sound dissipative device on a motor vehicle or motorcycle;

(c) The EPO/NCO may, by (guidelines) (regulations subject to approval by ________), list those acts which constitute violation of this section.

9.1.2 MOTOR VEHICLE HORNS AND SIGNALING DEVICES

The following acts and the causing thereof are declared to be in violation of this ordinance:

(a) The sounding of any horn or other auditory signaling device on or in any motor vehicle on any public right-of-way or public space, except (as a warning of danger)/(as provided in the vehicle code).

[(b) The sounding of any horn or other auditory signaling device which produces a sound level in excess of ______dBA at ______feet (meters).

9.1.3 REFUSE COLLECTION VEHICLES

No person shall:

(a) On or after (2 years) following the effective date of this ordinance, operate or permit the operation of the compacting mechanism of any motor vehicle which compacts refuse and which creates, during the compacting cycle, a sound level in excess of ______ dBA when measured at ______ feet (meters) from any point on the vehicle;

(b) Operate or permit the operation of the compacting mechanism of any motor vehicle which compacts refuse, between the hours of ______ p.m. and ______ a.m. the following day in a residential area or noise sensitive zone;

(c) Collect refuse with a refuse collection vehicle between the hours of ______ p.m. and ______ a.m. the following day in a residential area or noise sensitive zone.

9.1.4 STANDING MOTOR VEHICLES

No person shall operate or permit the operation of any motor vehicle with a gross vehicle weight rating (GVWR) in excess of ten thousand (10,000) pounds, or any auxiliary equipment attached to such a vehicle, for a period longer than _____ minutes in any hour while the vehicle is stationary, for reasons other than traffic congestion, on a public right-of-way or public space within 150 feet (46 meters) of a residential area or designated noise sensitive zone, between the hours of _____ p.m. and _____ a.m. the following day.

9.2 RECREATIONAL MOTORIZED VEHICLES OPERATING OFF PUBLIC RIGHTS-OF-WAY

(a) [Except as permitted in subsection (b) or (c),] no person shall operate or cause to be operated any recreational motorized vehicle off a public right-of-way in such a manner that the sound level emitted therefrom exceeds the limits set forth in Table 3 at a distance of 50 feet (15 meters) or more from the path of the vehicle when operated on a public space or at or across the boundary of private property when operated on private property. This section shall apply to all recreational motorized vehicles, whether or not duly licensed and registered, including, but not limited to, commercial or non-commercial racing vehicles, motorcycles, go-carts, snowmobiles, amphibious craft, campers and dune buggies, but not including motorboats.

[(b) Permits for motor vehicle racing events may be obtained from (appropriate authority) according to procedures and criteria set forth in __________.]

[(c) Special variances for __________ may be obtained from (appropriate authority) according to procedure and criteria set forth in __________.]

Table 3. Recreational Motorized Vehicle Sound Limits
(Measured at 50 Feet or 15 Meters)

Vehicle type	Sound level, dBA
Snowmobile	A
Motorcycle	B
Any other vehicle	C

ARTICLE X LAND USE

10.1 GENERAL PROVISIONS

(a) No owner of any land shall commence or cause to be commenced construction of any structure covered by Sections 10.2, 10.3, 10.5 or 10.6 unless approved by the EPO NCO as provided in this Article.

(b) Any application for approval required by this Article shall be submitted in writing to the EPO NCO, with a copy to the (Buildings Department)/(Appropriate Department), by the owner of the land on which the structure is proposed to be constructed and shall contain the following information:

(1) identification of the land on which the construction is proposed;

(2) the section of this Article under which approval is requested;

(3) information and data supporting the claim that the appropriate requirements will be met;

(4) any other information which the EPO NCO may reasonably require.

10.2 CONSTRUCTION RESTRICTIONS FOR HABITABLE AND INSTITUTIONAL STRUCTURES

(a) Except as provided in subsection (c), no new single family residential structure shall be approved for construction (excluding substantial repair or alteration) if the exterior day-night average sound level (L_{dn}) anywhere on the site of the proposed structure is projected to be in excess of _____ dBA within _____ years following the estimated completion date of the structure.

(b) Except as provided in subsection (c), no new multiple-family residence, dormitory, mobile home park, transient lodging, school, hospital, nursing home or similar structure, or substantial modification of such existing structure, shall be approved for construction if the exterior day-night average sound level (L_{dn}) anywhere on the site of the proposed structure is projected to be in excess of _____ dBA within _____ years following the estimated completion date of the structure or modification.

(c) Construction otherwise prohibited pursuant to subsections (a) or (b) shall be allowed if the exterior day-night average sound level (L_{dn}) on the site of the proposed structure is projected not to be in excess of

____ dBA for .. ___ years following construction, provided that there is incorporated into the design and construction of the structure such sound attenuation measures as are necessary to reduce the maximum interior day-night average sound level (L_{dn}) to _____ dBA. Subsections (a) and (b) shall not apply to any site development plan or its equivalent on which four or fewer dwelling units are to be constructed.

(d) Prior to issuance of any occupancy permit for any structure regulated pursuant to subsection (c), the owner of the structure shall submit for EPO/NCO review the report of an independent testing agency [approved by the EPO/NCO] certifying that sound attenuation measures have been properly incorporated into the design and construction of the structure and that the interior L_{dn} meets the criterion specified in subsection (c). Such report shall contain the results of simultaneous measurements of the exterior and interior day-night average sound levels for a representative sample of locations.

(e) The EPO/NCO may conduct such inspections and measurements as are necessary to ensure the accuracy of any report submitted pursuant to subsection (d) and to ascertain compliance with this section. These may include on-site inspections by a certified independent testing agency during specified periods of construction.

10.3 RECREATIONAL AREA RESTRICTIONS

(a) Except as provided in subsections (b), (c), and (d) no land shall be designated or approved for construction or use as a public or private exterior recreational area, including, but not limited to, childrens' playgrounds, outdoor theaters and amphitheaters, picnic grounds, tennis courts and swimming pools, if the exterior day-night average sound level (L_{dn}) anywhere on the site of the proposed recreational area is projected to be in the excess of _____dBA within _____ years following the construction or designation of the site.

(b) This section shall not apply to the designation or approval of any green belt or open space in any area in which the L_{dn} exceeds the level specified in subsection (a) regardless of whether such green belt or open space is open to public use, provided that no recreational improvement or facility is constructed thereon.

(c) Designation or approval of exterior recreational areas otherwise prohibited under subsection (a) shall be allowed if the L_{dn} specified in that subsection can be achieved by appropriate means of sound attenuation, such as berms, barriers, or buildings, at the perimeter of or elsewhere on the site.

(d) No new interior recreational facility, including, but not limited to, gymnasiums, ice or roller skating rinks, indoor swimming pools, and tennis courts, shall be approved for construction if the exterior day-night average sound level anywhere on the site is projected to be in excess of _____dBA within _____years following the estimated date of completion of the structure unless there is incorporated into the design and construction of the structure such sound attenuation measures as are necessary to reduce the maximum interior day-night average sound level (L_{dn}) to _____ dBA.

10.4 SITE STUDY REQUIREMENT

(a) If the EPO/NCO has reason to believe that a full report is necessary to determine whether a proposed project is prohibited under Section 10.1, such report shall be made by the applicant prior to approval of any subdivision, zoning, or building permit application. (If a full report has not been made and the applicant believes the project was wrongfully prohibited under Section 10.1, he may file a full report within _____ days of the EPO/NCO decision and request reconsideration by the EPO/NCO). A full report shall contain the following information and any other information which the EPO/NCO may reasonably require:

(1) the existing day-night average sound levels (L_{dn}), including identification of the major sources of sound, for a representative sample of locations, measured in accordance with guidelines published by the EPO/NCO;

(2) any projected or proposed new or expanded sources of sound which may affect exposure of the site during _____ years following completion of the project and the projected future L_{dn} at the site resulting from these new or expanded sources;

(3) where applicable, plans for sound attenuation measures on the site and/or of the structure proposed to be built and the amount of sound attenuation anticipated as a result of these measures.

(b) In determining whether an applicant should be required to submit a full report pursuant to subsection (a), the EPO/NCO shall consider Circular 1390.2 (Noise Abatement and Control) and other publications of the U.S. Department of Housing and Urban Development.

10.5 COMMERCIAL AND INDUSTRIAL CONSTRUCTION

No new or substantially modified structure on land used or zoned as commercial or industrial shall be approved for construction unless the owner or developer of such land has demonstrated, in accordance with guidelines published by the EPO/NCO, that the completed structure and the activities associated with and on the same property as the structure, will comply with the provisions of Article VIII at the time for initial full-scale operation of such activities.

10.6 SOUND FROM NEW TRANSPORTATION SYSTEMS IN RESIDENTIAL AREAS OR NOISE SENSITIVE ZONES

No plans for construction of new transportation systems or expansion of the capacity of existing transportation systems will be approved for location in or near residential areas or noise sensitive zones, regardless of the source of project funds, unless such plan includes all control measures necessary to ensure that the projected day-night average sound level (L_{dn}) due to the operation of the transportation system does not exceed ______ dBA at any point on residential property within ______ years after the expected completion of the project.

10.7 EQUIVALENT MEASUREMENT SYSTEMS

For the purposes of this Article, all measurements and designations of sound levels shall be expressed in day-night average sound levels (L_{dn}) or in any other equivalent measurement system the EPO/NCO may reasonably approve.

10.8 ZONING ORDINANCE OR COMPREHENSIVE PLAN

(a) No proposed zoning ordinance or comprehensive plan shall be approved unless such plan includes a sound analysis which (1) identifies existing and projected noise sources and associated sound levels for ______ years in and around the area under consideration, and (2) ensures usage of adequate measures to avoid violation of any provision of this ordinance.

(b) No zoning change application shall be approved unless the site feasibility study submitted, as required by the (Zoning Board of Appeals)/(Planning Commission), contains an analysis which shows (1) the impact of existing and projected noise sources for ______ years on the intended use, and (2) the projected noise impact of the intended use, when completed, on surrounding areas. Such site study shall ensure the use of adequate use of adequate measures to avoid violation of any provision of this ordinance.

10.9 TRUTH IN SELLING OR RENTING

No person shall sell or rent, or cause to be sold or rented, any structure or property to be used for human habitation, where the structure or property is exposed to sound levels regularly in excess of (an L_{eq} in any hour of ______ dBA)/(an L_{dn} of ______ dBA), without making full written disclosure to all potential buyers or renters of the existence of such sound levels and of the nature of the sources. The EPO/NCO shall develop a standard format for written disclosures, which shall include information on the effects of noise on human health and welfare.

10.10 APPEALS

Any applicant may appeal an adverse decision by the EPO/NCO under this Article, in the (appropriate court of law), on the grounds that the EPO/NCO disapproval was arbitrary, capricious, or unreasonable.

ARTICLE XI ENFORCEMENT

11.1 PENALTIES

(a) Any person who violates any provision of this ordinance shall be fined for each offense not more than ______ dollars.

(b) Any person who willfully or knowingly violates any provision of this ordinance shall be fined for each offense a sum of not less than ______ dollars and not more than ______ dollars.

(c) Each day of violation of any provision of this ordinance shall constitute a separate offense.

[11.2 ABATEMENT ORDERS

(a) Except as provided in subsection (b), in lieu of issuing a notice of violation as provided for in Section 11.3, the EPO/NCO or other (agency/official) responsible for enforcement of any provision of this ordinance may issue an order requiring abatement of any source of sound or vibration alleged to be in violation of this ordinance within a reasonable time period and according to guidelines [to be approved by appropriate authority] which the EPO/NCO may prescribe.

(b) An abatement order shall not be issued: (1) for any violation covered by Section 11.1 (b); (2) for any violation of ____________; or, (3) when the EPO/NCO or other enforcement (agency/official) has reason to believe that there will not be compliance with the abatement order.]

11.3 NOTICE OF VIOLATION

[Except where a person is acting in good faith to comply with an abatement order issued pursuant to Section 11.2 (a)], violation of any provision of this ordinance shall be cause for a (notice of violation)/(summons)/(complaint)/(information or indictment) to be issued by the EPO/NCO or other responsible enforcement (agency official) according to procedures (which the EPO/NCO may prescribe)/(set forth in ____________).

11.4 IMMEDIATE THREATS TO HEALTH AND WELFARE

(a) The EPO/NCO shall order an immediate halt to any sound which * exposes any person, except those excluded pursuant to subsection (b), to continuous sound levels in excess of those shown in Table 4 or to impulsive sound levels in excess of those shown in Table 5. Within _____days following issuance of such an order, the EPO/NCO shall apply to the appropriate court for an injunction to replace the order.

(b) No order pursuant to subsection (a) shall be issued if the only persons exposed to sound levels in excess of those listed in Tables 4 and 5 are are exposed as a result of (1) trespass; (2) invitation upon private property by the person causing or permitting the sound; or (3) employment ment by the person or a contractor of the person causing or permitting the sound.

(c) Any person subject to an order issued pursuant to subsection (a) shall comply with such order until (1) the sound is brought into compliance with the order, as determined by the EPO/NCO; or (2) a judicial order has superseded the EPO/NCO order.

(d) Any person who violates an order issued pursuant to this section shall, for each day of violation, be fined not less than ______ dollars nor more than _____dollars.

11.5 CITIZEN SUITS

(a) Any person, other than persons responsible for enforcement of this ordinance, may commence a civil action on his own behalf (1) against any person who is alleged to be in violation of any provision of this ordinance set forth in Table 6 below or (2) against the EPO/NCO where there is alleged a failure of the EPO/NCO to perform any act under this ordinance which is not discretionary. The __________ court shall have jurisdiction, without regard to the amount in controversy, to grant such relief as it deems necessary.

Table 4. Continuous Sound Levels which Pose an Immediate Threat to Health and Welfare (Measured at 50 Feet or 15 Meters)*

Sound level limit (dBA)	Duration
90	24 hours
93	12 hours
96	6 hours
99	3 hours
102	1.5 hours
105	45 minutes
108	22 minutes

*Use equal energy-time-intensity trade-off if level varies; find energy equivalent over 24 hours.

Table 5. Impulsive Sound Levels which Pose an Immediate Threat to Health and Welfare (Measured at 50 Feet or 15 Meters)

Sound level limit (dB)	Number of repetitions per 24 hour period
145	1
135	10
125	100

Table 6. Provisions Under Which Civil Actions May Be Commenced

6.2.1 (a)	(Radios, Television Sets, Musical Instruments and Similar Devices)
6.2.2	(Loudspeakers/Public Address Systems)
6.2.3	(Street Sales)
6.2.5	(Loading and Unloading)
6.2.6	(Construction)
6.2.7	(Vehicle or Motorboat Repairs and Testing)
6.2.9	(Places of Public Entertainment)
6.2.10	(Explosives, Firearms, and Similar Devices)
6.2.11	(Powered Model Vehicles)
6.2.12	(Vibration)
[6.2.13]	(Stationary, Non-Emergency Signaling Devices)
6.2.14	(Emergency Signaling Devices)
6.2.15	(Motorboats)
6.2.17	(Domestic Power Tools)
6.2.18	(Tampering)
8.1	(Maximum Permissible Sound Levels by Receiving Land Use)
9.1.3	(Refuse Collection Vehicles)
9.1.4	(Standing Motor Vehicles)
9.2 (b)	(Motor Vehicle Racing Events)
9.2.1 (b)	(Motor Vehicle Horns and Signaling Devices)
10.9	(Truth in Selling or Renting)

(b) No action may be commenced

(1) under subsection (a)(1)

(A) prior to ______ days after the plaintiff has given notice of the alleged violation to the EPO/NCO [and to the alleged violator] of such violation, or

(B) if the EPO/NCO has commenced and is diligently prosecuting an action against the alleged violator with respect to such violation, [but in such action any affected person may intervene as a matter of right], or

(2) under subsection (a)(2), prior to ______ days after the plaintiff has given notice to the EPO/NCO that he will commence such action. Notice under this subsection shall be given in a manner prescribed by the EPO/NCO.

(c) In any action under this section, the EPO/NCO, if not a party, may intervene as a matter of right.

(d) The court, in issuing any final order in any action brought pursuant to subsection (a), may at its discretion award the costs of litigation to any party.

11.6 OTHER REMEDIES

No provision of this ordinance shall be construed to impair any common law or statutory cause of action, or legal remedy therefrom, of any person for injury or damage arising from any violation of this ordinance or from other law.

11.7 SEVERABILITY

If any provision of this ordinance is held to be unconstitutional or otherwise invalid by any court of competent jurisdiction, the remaining provisions of the ordinance shall not be invalidated.

11.8 EFFECTIVE DATE

This law/ordinance shall take the effect on ____________________

Appendix VI-2

Suggested State Noise Control Act

Title 1

Section 101. [Short Title.] This Act may be cited as the [State] Noise Control Act.

Section 102. [Findings and Policy.] The Legislature finds and declares that:

(1) Excessive noise is a serious hazard to the public health and welfare and the quality of life.

(2) A substantial body of science and technology exists by which excessive noise may be substantially abated.

(3) Each person has a right to an environment free from noise that may jeopardize his health or welfare or degrades the quality of life.

(4) It is the policy of the State to prevent noise which may jeopardize the health or welfare of the public or degrades the quality of life.

Section 103. [Definitions.] As used in this Act:

(1) "Administrator" means the head of the state agency administering the state noise control program.

(2) "Agency means the state agency administering the state noise control program.

(3) "Local government" means [here insert appropriate unit (county, municipality, etc.) and any limits as to size or type of unit to which this Act shall apply].

(4) "Noise" means the intensity, frequency, duration, and character of sounds from a source or number of sources. Noise includes vibrations of sub-audible frequency.

(5) "Person" means an individual, corporation, partnership, or association, and includes any officer, employee, department, agency, or instrumentality of the United States, a State, or any political subdivision of a State.

(7) "Product" means any manufacturered article or goods or component thereof.

Section 104. [State Agencies.]

(a) State agencies shall, to the fullest extent consistent with their authorities under state laws administered by them, carry out the programs within their control in such a manner as to further the policy stated in Section 102 of this Act.

(b) State agencies shall cooperate with the administrator in a state program of noise regulation developed and maintained under this Act.

(c) Each department, agency, or instrumentality of the executive, legislative, and judicial branches of the government of this State (1) having jurisdiction over any property or facility, or (2) engaged in any activity resulting, or which may result, in the emission of noise, shall comply with federal, state, interstate, and local requirements respecting control and abatement of environmental noise to the same extent that any person is subject to such requirements.

(d) Each state or local agency preparing an environmental impact statement pursuant to [state environmental policy act, if any] shall, when the environmental impacts of the proposed action include noise, submit such statement to the administrator for his comments.

(e) Each state agency shall consult with the administrator in prescribing standards or regulations respecting noise. If at any time the administrator has reason to believe that a standard or regulation, or any proposed standard or regulation, of any agency respecting noise does not protect the public health and welfare to the extent he believes to be required and feasible, he may request such agency to review and report to him on the advisability of revising such standard or regulation to provide such protection. Such agency shall complete the requested review and report to the administrator within such time as the administrator specifies, but such time specified may not be less than 60 days from the data the request was made.[1]

Title 2

Section 201. [Adoption of Comprehensive Noise Regulation Program, Rules and Regulations.][2]

(a) The administrator [or appropriate state board or agency] shall develop, adopt and maintain a comprehensive statewide program of noise regulation which may include, but not be limited to, the following.

---

[1] For those States which so desire, the request and report may be by law required to be published in any equivalent of the Federal Register.

[2] States should be aware of the preemption provisions of Section 6(e) (Noise Emission Standards for Products Distributed in Commerce, 8(c) (Labeling), 17(c) (Railroad Noise Emission Standards), and 18(c) (Motor Carrier Noise Emission Standards) of the Federal Noise Control Act of 1972 and of litigation presently pending concerning the scope of federal preemption with respect to airport noise.

(1) controls on environmental noise (or one or more sources thereof) through the licensing, regulation, and restriction of the use, operation, and movement of any product or combination of products;

(2) noise emission standards for products which, in the administrator's judgment, are major sources of noise, or are products for which noise emission standards are feasible and are requisite to protect the public health and welfare. Such standards may include but shall not be limited to adoption by reference of standards or regulations adopted by the administrator of the United States Environmental Protection Agency pursuant to the Noise Control Act of 1972 (Public Law 92-574) or any amendment thereto;

(3) labeling requirements which prohibit the sale or offer to sell or the lease or offer to lease of any product, or class or category thereof, without notice to the prospective purchaser, lessee, or user of the noise levels and characteristics emitted by such product, or its effectiveness in reducing noise, as the case may be;

(4) development and adoption of ambient noise standards;

(5) development and adoption of a plan for the achievement of ambient noise standards;

(6) noise insulation and abatement standards for any occupancy or class of occupancies of buildings, and the limitation of human exposure to noise generated by sources interior to such buildings. Such noise insulation and abatement standards shall be based on criteria for the limitation of noise exposures appropriate to building and occupancy use;

(7) establishment of special noise insulation districts within which specified building performance standards and noise insulation standards shall apply, in order to protect building occupants from excessive noise of external origins;

[OPTION: In the event that appropriate building regulatory legislation has been enacted by the State, insert the following after Section 202(14) in lieu of (6) and (7) above:

(15) Consult with state and local governmental agencies when such agencies adopt and enforce codes, standards and regulations dealing with noise insulation and abatement for any occupancy or class of occupancy.]

(8) regulations for the protection of all employed persons within the State against exposure to excessive noise at their place of work;

[OPTION: If a state agency presently has power to regulate occupational health and safety, including noise exposure, insert after Section 202(15) in lieu of (8) above:

(16) Consult with state agencies adopting regulations for the protection of employed persons within the State against exposure to excessive noise at their place of work.]

(9) license, registration, or permit requirements for the construction, installation, use and operation of machinery, equipment or facilities, or classes thereof, including such conditions as the administrator may deem appropriate for the purposes of the Act;

(10) control on airport and aircraft noise to the extent not preempted by federal law. It is not the intention of this subdivision to preempt power of local governments, whether their capacity as proprietors of airports or under police powers;[3]

(11) procurement standards which establish mandatory noise performance specifications for products purchased by state agencies or utilized in the performance of contracts funded wholly or in part by state monies.

(b) (1) Any regulation promulgated pursuant to the authority of this Act shall be one which, in the judgment of the administrator [or appropriate state agency], is requisite to protect the public health and welfare, taking into account the magnitude and conditions of use of the product or activity involved alone or in combination with other sources, the degree of noise reduction achievable through the application of the best available technology without undue restriction to interstate commerce, and the cost of compliance. In determining the degree of noise reduction achievable through the application of the best available technology, the administrator [or appropriate state agency] shall take into consideration technology which may be available at the time the regulation becomes effective. In considering availability, agency shall weigh the utility of the activity in relation to the cost of the technology.

(2) Regulations promulgated pursuant to this Act shall be adopted following a public hearing and pursuant to the provisions of State Administrative Procedures Act .

(3) Regulations promulgated pursuant to the authority of this Act shall be applicable throughout the State or to such parts or regions thereof specifically designated in such regulations.[4]

---

[3] This section has been left flexible so that States may adopt regulations that reflect the apportionment of powers to be decided in Burbank v. Lockheed, now pending in the United States Supreme Court.

[4] We recommend the Legislature imposed time deadlines for the enactment of the regulations required by Section 201 in accordance with available funding and priorities as perceived by each individual State. Where such deadlines are set, the Legislature should designate with specificity the regulations to be adopted within the period set.

Section 202. [Administrative Powers and Duties] In order to implement the purposes of this Act, the administrator shall have the power to:

(1) cause to be conducted a program of studies, research and monitoring related to environmental noise;

(2) review and comment upon environmental impact statements regarding projects having any portion of their potential impact within the borders of this State and (a) prepared in compliance with the National Environmental Policy Act of 1969 (42 U.S.C. Sect. 4321 et seq.) or, (b) prepared in compliance with [State Environmental Policy Act, if any], where the environmental impact of the proposed project includes noise;

(3) provide technical assistance to other state agencies and to political subdivisions of this State, including drafts of model local ordinances;

(4) conduct programs of public education regarding the causes and effects of noise and means for its abatement and control and encourage the participation of professional, scientific, conservation and other public interest groups in related public information efforts;

(5) coordinate the programs of all state and local agencies relating to noise studies and noise control;

(6) cooperate with the appropriate agencies of the United States, or of other States or any interstate agencies with respect to the control, prevention and abatement of noise;

(7) receive and disburse all funds pertaining to the State's noise control program from private and public sources;

(8) contract for property and services, including consulting services;

(9) appoint such advisory groups and committees as may be necessary to assist in carrying out the state noise regulation program; [Here insert any conditions or limitations concerning advisory groups (such as reimbursement for expenses) or the state statute applicable to advisory groups, if any.]

(10) upon presentation of proper credentials, enter any building, property, premises, or place and inspect any noise source for the purpose of ascertaining the compliance or non-compliance with any regulation which may have been adopted by the administrator [or appropriate state agency] hereunder. If, in connection with such inspection or investigation, noise measurements, recordings or tests of any type are taken for analysis, a duplicate of the analytical report shall be furnished to the person who is suspected of causing such noise pollution or is responsible therefor;

(11) have access to, and require the production of, books and papers pertinent to any matter under investigation;

(12) require the over or operator of any noise source to establish and maintain records and make such reports and furnish such information as the administrator may reasonably prescribe;

(13) require the owner or operator of any noise source to sample the emissions thereof in accordance with such methods and procedures and at such locations and intervals of time as the administrator may reasonably prescribe and to provide the administrator with the results thereof; and

(14) investigate complaints, institute and conduct surveys and testing programs, conduct general ambient noise sampling programs, make observations of conditions which may or do cause or affect noise pollution, make tests or other determinations of noise sources, and assess the degree of abatement required.

Section 203. [Procurement of Low-Noise-Emission Products.]

(a) The administrator shall certify any product:

(1) which has been certified by the administrator of the United States Environmental Protection Agency pursuant to Section 15 of the Noise Control Act of 1972 as a low-noise-emission product or which the administrator determines emits noise in amounts significantly below the levels specified in noise emission standards issued pursuant to federal law or this Act; and

(2) which he determines is suitable for use as a substitute for a type of product at that time in use by agencies of the state government.

(b) Certification under this section shall be effective for a period of one year from the data of issuance.

(c) Products certified pursuant to subsection (a) of this section shall be acquired by purchase or lease by the state government for use by the state government in lieu of other products if [state procurement officer or other appropriate officials] determines that such certified products have procurement costs which are no more than 125 percent of the retail price of the least expensive type of product for which they are certified substitutes. In making purchasing selections between competing eligible certified products, the procuring agency shall give priority to any class or model which does not require extensive periodic maintenance to retain its low noise qualities or which does not involve operating costs significantly in excess of those products for which it is a certified substitute. The term "retail price" means (a) the maximum statutory price applicable to any type of product; or (b) in any case where there is no applicable maximum statutory price, the most recent price paid for any type of product.

(d) Any statutory price or bid limitations notwithstanding, any county, municipality or other political subdivision may acquire by purchase or lease a certified low-noise-emission product in lieu of other products if it determines that such certified product has procurement costs which are no more than 125 percent of the retail price of the least expensive type of product for which it is certified as a substitute.

(e) The administrator shall, from time to time as he deems appropriate, test the emissions of noise from certified products purchased by the state government. If at any time he finds that the noise emission levels exceed the levels on which certification was based, the administrator shall give the supplier of such product written notice of this finding and give the supplier an opportunity to make necessary repairs, adjustments or replacements. If no such repairs, adjustments, or replacements are made within a period to be set by the administrator, he may order the supplier to show cause why the product involved should be eligible for recertification.

(f) The administrator shall promulgate the procedures required to implement this section.

Section 204. [Granting of Variances.] The administrator [or appropriate state board or agency] may grant individual variances beyond the limitations prescribed in this Act or in any regulation promulgated pursuant to this Act, whenever it is found, upon presentation by the petitioner of adequate proof, that compliance with any provision of this Act, any regulation promulgated under it or an order of the administrator would impose an arbitrary or unreasonable hardship. In granting or denying a variance, the administrator [or appropriate state board or agency] shall file and publish a written opinion stating the facts and reasons leading to his decision.

Section 205. [Conditions for Variances.]

(a) In granting a variance the administrator [or appropriate state board or agency] may impose such conditions as the policy of this Act requires. If the hardship complained of consists solely of the need for a reasonable delay in which to correct a violation of this Act or of the regulations promulgated under it, the administrator or appropriate state board or agency may condition the grant of such variances upon the posting of sufficient performance bond or other security to assure the correction of such violation within the time prescribed.

(b) Variances shall be granted pursuant to this Act in accordance with the following provisions:

(1) The administrator shall designate a schedule of compliance specifying a definite time period within which full compliance with this Act and the rules and regulations adopted hereunder shall be achieved.

(2) In order to implement the schedule of compliance, a variance may be granted pursuant to the provisions of this Act for such period of time not exceeding one year, as shall be specified by the administrator. Such variance may be renewed for additional periods of one year by affirmative action of the administrator, but only if satisfactory progress toward compliance in accordance with the schedule of compliance has been shown.

Section 206. [Filing for Variances.] Any person seeking a variance shall do so by filing a petition for variance with the agency. The agency shall promptly give written notice of such petition to any person in the county in which the installation, property, or activity for which variance is sought is located who has in writing requested notice of variance petitions, and shall publish notice of such petition in a newspaper of general circulation in such county and in any state equivalent of the Federal Register . The agency shall promptly investigate such petition and shall consider the views of persons who might be adversely affected by the grant of a variance. If the administrator or appropriate state board or agency , in his discretion, concludes that a hearing would be advisable, or if any person files a written request for a hearing or a written objection to the grant of such variance within [ ] days of the notice provided herein, a hearing shall be held under State Administrative Procedures Act .

Section 207. [Administrator's Report.] The administrator shall prepare annually or such other appropriate period a report to the Governor and the Legislature on his progress in abating and preventing noise, including the administrator's recommendations for any further legislation needed to implement the State's policy as stated in Section 102 of this Act. The first such report shall be submitted one year after the effective date of this Act.

[OPTION: If there is already a requirement for a report on environmental programs, the following alternative may be substituted:

In each report submitted pursuant to [state statute requiring environmental report], the administrator shall include information concerning his progress in abating and preventing noise and the administrator's recommendations for any further legislation needed to implement the State's policy as stated in Section 102 of this Act.]

Title 3

Section 301. [Local Programs.] All local governments, as defined in Section 103(3) of this Act, shall may develop, adopt, amend and maintain a comprehensive program of noise regulation. Such program [shall][may] include a study of the noise problems resulting from uses and activities within its jurisdiction and the development and adoption of a Noise Control Plan.

Section 302. [Noise Control Program.] Any Noise Control Plan adopted pursuant to Section 301 of this Act [shall][may] include, but not be limited to, the following:

(1) noise levels which will not be exceeded in specified zones or other designated areas;

(2) the designation of a Noise Control Officer;

(3) plans, and procedures necessary for the implementation of plans, for transportation systems within the jurisdiction;

(4) plans concerning land use within the jurisdiction;

(5) requirements of building design necessary for the approval of any construction within the jurisdiction;

(6) the implementation procedures of the Noise Control Plan and the relation of the Noise Control Plan to other plans within the jurisdiction;

(7) strategies for assuring compliance with state and federal noise regulations;[5]

(8) noise level restrictions applicable to construction activities.

Section 303. [Local Powers.] Local governments [may][shall] adopt and enforce ordinances necessary to implement the Noise Control Plan and any other program adopted pursuant to Section 301 of this Act.[6] Ordinances adopted pursuant to this section may include more stringent standards than those adopted by the administrator [or appropriate state board or agency].

Title 4

Section 401. [Unlawful Acts] It shall be unlawful for any person to:

(1) violate or fail to comply with this Act or any regulation adopted pursuant to it, or the terms or conditions of any permit, license, variance or order issued pursuant to this Act or pursuant to any regulation adopted hereundor;

(2) refuse, hinder, or interfere with by force or otherwise the performance by the administrator or by any duly authorized agent or employee of the agency or their assistants of any duty under the provisions of this Act; or to refuse to such agent, employee, or assistant entrance to any premises upon proper identification and presentation of a search warrant; or to hinder or interfere with the conduct of an inspection, test, or taking of a samply by such authorized agent, employee, or assistant where entry to the premises was obtained by consent, or by presentation of proper identification, and search warrant;

(3) on any property or premises owned or leased by such person, allow the creation, continuance, or maintenance of any noise, or allow the installation, use or operation of any noise source, which noise or source violates or fails to comply with this Act, or any regulation adopted pursuant to this Act, or the terms or conditions of any permit, license, variance, or order issued pursuant to this Act or pursuant to any regulation adopted hereunder;

(4) intentionally remove or render inoperable, other than for purposes of maintenance, repair or replacement, any device or element of design incorporated, in compliance with this Act, into any product, structure, machine, equipment, vehicle or appliance for the control, abatement or prevention of noise emissions, either prior or subsequent to the sale or delivery to the ultimate purchaser; to to use such product, structure, machine, equipment, vehicle or appliance after such device or element of design has been removed or rendered inoperable with knowledge of the removal or rendering inoperable of such device or element of design;

(5) remove any notice affixed to a product or container pursuant to regulations prescribed under Section 201(a)(3) prior to sale of the product to the ultimate purchaser;

(6) attempt to obtain a permit, license, registration or variance required or permitted under this Act or any regulations adopted pursuant hereto by misrepresentation or failure to disclose all relevant facts.

Section 402. [Search Warrants.] Whenever an agent or employee ofthe administrator has been refused access to property, or has been refused the right to examine any noise source or noise control equipment or device, or has been refused access to or examination of books, papers, and records pertinent to any matter under investigation, or reasonably requires access to such property, source, equipment, device, books, papers or records without prior notice to the owner, such agent or employee may apply for a search warrant to any state official authorized by the laws of the State to issue the same to enable him or her to have access and examine such property, noise source, control equipment or device, or books, papers, and records. It shall be sufficient probable cause to issue a search warrant that the inspection or examination is necessary to properly enforce the provisions of this Act or the standards, rules and regulations adopted pursuant hereto.

---

[5] States may wish to provide a procedure whereby local Noise Control Plans must be approved by the administrator and/or are more closely interrelated with the state noise control program.

[6] This authority may be too broad to comply with the laws and constitutions of some States.

Section 403. [Civil Remedies] [The Legislature may include here procedures for the issuance and administrative adjudication of orders of the administrator of of the suspension or revocation of permits, licenses and variances according to applicable state law. State authorities may be given power to enforce local noise laws or regulations. A provision authorizing anyone entitled to bring actions in the name of the State to seek enforcement of the order may be included. Civil remedies including fines and injunctions may also be included. States may wish to consider giving complaining citizens a portion of fines collected and/or attorneys' fees and costs, including witness fees and investigation costs][7]

Section 404. [Criminal Penalties.] [The Legislature may include here any criminal penalties (including fines and periods of imprisonment) to be imposed for violations of any provision of this Act, regulations promulgated pursuant to this Act or order of the administrator.]

Section 405. [Citizens' Suits.] Any person may commence a civil suit on his own behalf against any person who is alleged to be in violation of any provision of this Act or of any regulation established pursuant to this Act, or against the administrator [or appropriate state board or agency] where there is alleged a failure of the administrator [or appropriate state board or agency] to perform any act or duty under this Act which is not discretionary with such administrator [or appropriate state board or agency].

Title 5

Section 501. [Savings Clause] The provisions of this Act are not exclusive, and the remedies provided for in this Act shall be in addition to any other remedies provided for in any other law or available under common law.

Section 502. [Severability.] It is the intent of the Legislature that the provisions of this Act shall be severable. In the event that any provision hereof, or regulation issued hereunder, shall be held to be in violation of any provision of the Constitution of the United States, or of the State, or of any provision of federal law, then all other provisions hereof or regulations issued hereunder shall remain in full force and effect.

Section 503. [Effective Data.] This Act shall take effect ...

States may wish to consider the creation of a special noise prevention and abatement fund to receive grants, gifts, fines, and penalties collected pursuant to the Act to be used upon appropriation of the State Legislature for noise control and abatement.

Appendix VI-3

California Noise Insulation Standards

(California Administrative Code, Title 25, Chapter 1, Subchapter 1; Adopted February 22, 1974)

Article 4. Noise Insulation Standards

1092. Noise Insulation Standards

(a) Purpose. The purpose of this article is to establish uniform minimum noise insulation performance standards to protect persons within new hotels, motels, apartment houses, and dwellings other than detached single-family dwellings from the effects of excessive noise, including but not limited to hearing loss or impairment and persistent interference with speech and sleep.

(b) Application and Scope. The provisions of this article relating to noise insulation performance standards apply to new hotels, motels, apartment houses and dwellings other than detached single-family dwellings.

These regulations shall apply to all applications for building permits made subsequent to the effective date of these regulations.

These regulations shall be effective 6 months after the adoption by the Commission and Housing and Community Development.

(c) Definitions. The following special definitions shall apply to this article as applicable:

(1) Impact Insulation Class (IIC) - A single number rating for ceiling-floor construction that represents the ability of the construction to isolate impact noise, where measurement procedure is based on ASTM E492-73T and as defined in UBC Standard No. 35-2.

(2) Sound Transmission Class (STC) - A single figure rating for floor-ceiling and interior wall partition construction that represents the ability of the construction to isolate airborne noise, where measurement procedure is based on ASTM E90-70 or ASTM E366-71 and as defined in UBC Standard No. 35-1.

(3) Detached Single-Family Dwelling - Any single-family dwelling which is separated from adjacent property lines by 3 feet or more or is separated from adjacent buildings by 6 feet or more.

(d) Sound Transmission Control Between Dwelling Units.

(1) Wall and Floor-Ceiling Assemblies. Wall and floor-ceiling assemblies separating dwelling units or guest rooms from each other and from public space such as interior corridors and service areas shall provide airborne sound insulation for walls, and both airborne and impact sound insulation for floor-ceiling assemblies.

(2) Airborne Sound Insulation. All such separating walls and floor-ceiling assemblies shall provide an airborne sound insulation equal to that required to meet a Sound Transmission Class (STC) of 50 (45 if field tested) as defined in UBC Standard No. 35-1.

Penetrations or openings in construction assemblies for piping, electrical devices, recessed cabinets, bathtubs, soffits, or heating, ventilating or exhaust ducts shall be sealed, lined, insulated or otherwise treated to maintain the required ratings.

Dwelling unit entrance doors from interior corridors together with their perimeter seals shall have a Sound Transmission Class (STC) rating of not less than 30 and such perimeter seals shall be maintained in good operating condition.

(3) Impact Sound Insulation. All separating floor-ceiling assemblies between separate units or guest rooms shall provide impact sound insulation equal to that required to meet an Impact Insulation Class (IIC) of 50 (45 if field tested) as defined in UBC Standard No. 35-2. Floor coverings may be included in the assembly to obtain the required rating, and must be retained as a permanent part of the assembly and may only be replaced by other floor covering that provides the same sound insulation required above.

(4) Tested Assemblies. Field or laboratory tested wall or floor-ceiling designs have an STC or IIC of 50 or more as determined by UBC Standard 35-1, 35-2, or 35-3 may be used without any additional field testing when in the opinion of the Buidling Officials, the laboratory tested design has not been compromised by flanking paths. Tests may be required by the Building Official when evidence of compromised separations is noted.

(5) Field Testing. Field testing, when required, shall be done under the supervision of a person experienced in the field of acoustical testing and engineering, who shall forward test results to the Building Official showing that the minimum sound insulation requirements stated above have been met.

(6) **Airborne Sound Insulation Field Tests.** When required, airborne sound insulation shall be determined according to the applicable Field Airborne Sound Transmission Loss Test procedures of UBC Standard No. 35-3. All sound transmitted from the source room to the receiving room shall be considered to be transmitted through the test partition.

(7) Impact Sound Insulation Field Test. When required, impact sound insulation shall be determined in accordance with UBC Standard 35-2.

(NOTE: Excerpts from the 1973 UBC Appendix Chapter 35, reproduced with permission of International Conference of Building Officials, 5360S. Workman Mill Road, Whittier, California.)

(e) Noise Insulation from Exterior Sources.

(1) Location and Orientation. Consistent with land use standards, residential structures located in noise critical areas, such as proximity to select system of county roads and city streets (as specified in 186.4 of the State of California Streets and Highways Code), railroads, rapid transit lines, airports, or industrial areas shall be designed to prevent the intrusion of exterior noises beyond prescribed levels with all exterior doors and windows in the closed position. Proper design shall include, but shall not be limited to, orientation of the residential structure, set backs, shielding, and sound insulation of the building itself.

(2) Interior Noise Levels. Interior community noise equivalent levels (CNEL) with windows closed, attributable to exterior sources shall not exceed an annual CNEL of 45 dB in any habitable room.

(3) Airport Noise Source. Residential structures to be located within an annual CNEL contour (as defined in Title 4, Subchapter 6, California Administrative Code) of 60 require an acoustical analysis showing that the structure has been designed to limit intruding noise to the prescribed allowable levels. CNEL's shall be as determined by the local jurisdiction in accordance with its local general plan.

(4) Vehicular and Industrial Noise Sources. Residential buildings or structures to be located within exterior community noise equivalent level contours of 60 dB of an existing or adopted freeway, expressway, major street, thoroughfare, railroad or rapid-transit line shall require an acoustical analysis showing that the proposed building has been designed to limit intruding noise to the allowable interior noise levels prescribed in Section 1092(e)(2).

Exception: Railroads, where there are no nighttime (10:00 p.m. to 7:00 a.m.) railway operations and where daytime (7:00 a.m. to 10:00 p.m.) railway operations do not exceed four (4) per day.

(f) Compliance

(1) Evidence of compliance shall consist of submittal of an acoustical analysis report, prepared under the supervision of a person experienced in the field of acoustical engineering, with the application for building permit. The report shall show topographical relationship of noise sources and dwelling site, identification of noise sources and their characteristics, predicted noise spectra at the exterior of the proposed dwelling structure considering present and future land usage, basis for the prediction (measured or obtained from published data), noise attenuation measures to be applied, and an analysis of the noise insulation effectiveness of the proposed construction showing that the prescribed interior noise level requirements are met. If interior allowable noise levels are met by requiring that windows be unopenable or closed, the design for the structure most also specify the means that will be employed to provide ventilation, and cooling if necessary, to provide a habitable interior environment.

(2) Field Testing. Only when inspection indicates that the construction is not in accordance with the approved design, field testing may be required. Interior noise measurements shall be taken under conditions of typical maximum exterior noise levels within legal limits. A test report showing compliance or noncompliance with prescribed interior allowable levels shall be submitted to the Building Official.

Where a complaint as to noncompliance with this article requires a field test to resolve the complaint, the complainant shall post a bond or adequate funds in escrow for the cost of said testing. Such costs shall be chargeable to the complainant when such field tests show that compliance with these regulations is in fact present. If such tests show noncompliance, then such testing costs shall be borne by the owner or builder.

Footnotes

1. Office of Noise Abatement and Control, U.S.E.P.A. *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*. Washington: U.S.E.P.A. 1974 (PB-239 429).
2. *ibid.*
3. *ibid.*
4. *ibid.*
5. *ibid.*
6. *ibid.*
7. Chanard, R.C. and R.A. Simmons. *Community Noise Ordinance Workbook.* Denver: U.S.E.P.A., Region 8, 1860 Lincoln St. 80203. DRAFT, In Preparation.
8. *ibid.*
9. National Institute of Municipal Law Officers and U.S.E.P.A., *Model Community Noise Control Ordinance*. EPA 550/9-76-003, September 1975.
10. Bragdon, C.R. "Municipal Noise Ordinances, 1975." *Sound and Vibration* 9(12):24-30, December 1975. (The list of ordinances is a yearly feature; *S)V* is available from Acoustical Publications, 27101 E. Oviatt Rd, Bay Village, OH 44140)
11. *ibid.*
12. Office of Noise Abatement and Control, *op. cit.*
13. Chanard and Simmons, *op.cit.*
14. National Institute of Municipal Law Officers, *op.cit.*
15. NIMLO, *op. cit.*
16. see Appendix for text of ordinance
17. Another similar measure of noise -- Community Noise Exposure Level.
18. NIMLO, *op. cit.*
19. Urban Systems Research and Engineering, Inc. *The Audible Landscape: A Manual for Highway Noise and Land Use*. Washington: U.S. Department of Transportation, Federal Highway Administration, 1974.
20. Office of Noise Abatement and Control, U.S. EPA, *1974 Survey of State and Municipal Noise Control Activities*, Washington, D.C.: ONAC, 1975, DRAFT.
21. *ibid.*

22. Senko, A. et al. New York Urban Noise Survey Methodology. Cedar Knolls, N.J.: L.S. Goodfriend Associates, 1971. (PB-210 306)

Sutherland, L.C. et al. A Program for the Measurement of Environmental Noise in the Community and Associated Human Response. El Segundo, CA: Wyle Laboratories, 1973. (PB-228 563 and PB-228 564).

Bishop, D.E. Program for the Measurement of Environmental Noise. Canoga Park, CA: Bolt, Beranek, and Newman, 1973. (PB-225 305)

23. Office of Noise Abatement and Control, op.cit.

24. Ibid.

25. Chanard and Simmons, op. cit.

26. 1974 Survey of State and Municipal Noise Control Activities

27. ibid.

28. Council of State Governments. Recommended State Legislation, 1974. Lexington, KY: Council of State Governments, 1974.

SECTION VII

SOLID WASTE CONTROL

The responsibility for solid waste management has traditionally fallen on local governments, and there are no signs that the federal government will enter the field with major programs. Federal and state roles are primarily regulatory in nature; standards are being promulgated for collection, disposal, and resource recovery, and a few demonstrations and technical assistance efforts are underway. Although some states are setting up authorities to aid in the recycling or recovery of waste, local and regional governments will continue to be the focus of operations.

The environmental impacts of solid waste management are broad and complex. In some areas, such as public health protection, conventional systems perform fairly well; in others, such as waste-related water pollution control, they are much less effective. Because the severity of these impacts vary greatly according to local conditions, it is impossible to quantify them here, but most categories of environmental impacts are associated with solid waste as described below:

Air pollution arises from three waste-related causes: vehicle emissions, waste processing, and landfill decay gases. Vehicle emissions can be reduced in a number of ways, such as improved truck routing; they are generally minor. Gas emissions from incineration or other processing are controlled by state air pollution agencies, often with little realization that the solid waste is also a pollutant, and that strict enforcement only shifts the way in which the pollution will occur. Landfill gases, mostly methane and carbon dioxide, pose a safety hazard and can be controlled in well-designed landfills.

Water pollution also results from solid waste. Leachate and runoff from improperly managed landfills can pollute the groundwater and surface streams, and the pollutants can contain high portions of toxics, viruses, and metals. Water pollution arises from urban storm runoff, caused by spillage or littering of solid wastes on draining surfaces.

Land use impacts associated with landfills can be important. Landfills can reclaim marginal land for uses such as parks, or for some types of building sites, but poor design and operation can lead to subsidence and to reductions in the property values of landfill neighbors, through odors, blowing paper, and aesthetic impacts.

The impacts of solid waste on community noise are fairly small, except in the neighborhood of processing and disposal sites, where operation requires heavy equipment, and where the truck traffic is concentrated. Noise in waste collection is also a problem, although the newer vehicles show greatly reduced noise levels. Procurement of collection vehicles should consider factors such as noise, life-cycle cost, energy use, and safety.

Materials and energy use can be reduced through solid waste management. On one hand, recycling centers and resource recovery plants can increase the use of reclaimed materials; on the other, careful truck routing and planning can conserve energy and materials in operating the system.

Solid waste and the solid waste management system affect public health and safety in a number of direct ways. Litter and uncontrolled waste present obvious fire and disease hazards, particularly in poorer and older areas. The primary justification for public solid waste collection is to remove these hazards, and the breeding grounds for rodents and insects that compound them. Safety hazards are also associated with the collection process itself; solid waste collection is one of the most injury-prone of professions.

The necessary response to these complex environmental impacts must be a comprehensive management program, and consequently local governments view solid waste much more from a management than from an environmental point of view. To some, the solid waste problem has been how to collect the waste in an efficient and environmentally sound manner, without exorbitant costs of $30 to $40 per ton. To others, the basic problem has been to find disposal sites that can actually be used, and not vetoed by citizen resistance; the real costs and environmental effects of landfills are often unimportant to local citizens in comparison to the impacts on them of a nearby site. Litter is a third area of concern, and the basis of more citizen complaints than anything except waste not picked up on collection day. Leaf pickups have thrown many communities into chaos after bans on outdoor burning (to reduce air pollution) led to great increases in yard material collection. The list goes on, but these perceptions are typical of how "the solid waste problem" is seen on the local level.

Environmental regulations affecting solid waste must of necessity be keyed to procedural and management issues more than to indices of ambient environmental quality. The EPA Model Solid Waste Ordinance, contained in an appendix to this section, describes a number of procedures for improving systems operations, and there are numerous guides and manuals available to aid in solid waste management.[1,2,3] This chapter will not attempt to repeat the material contained in all of them.

Instead, this chapter concentrates on less common approaches, extensions and expansions of common practices that have potential for local environmental quality improvements. Included are such topics as improved litter prevention and suggestions for household storage control and source separation programs. These topics are usually overshadowed by the continuing operational problems of collecting the waste on time, and disposing of it at an acceptable site. In addition, some of the secondary implications of a number of increasingly popular options are discussed, such as the potential adverse impacts of some collection pricing schemes.

The chapter is broken up into four sections. In the first, the problems of solid waste management are briefly discussed. The second section describes procedures for controlling pollutants from solid waste, and the third evaluates these alternatives according to their costs and benefits. The final section describes model ordinances, programs, and sources of information on the proposed improvements.

THE SOLID WASTE PROBLEM

Conventional Collection

Most municipalities understand the problems faced in conventional solid waste management systems. First and foremost, the waste must be collected. Spillage must be kept to a minimum, and efficiency must be improved to keep costs manageable. Private firms must be regulated to insure that they perform in an environmentally acceptable manner, since their incentives are to maximize profit, rather than maximize service quality. Resource books such as Solid Waste Collection Practice by the American Public Works Association and Decision Maker's Guide to Solid Waste Management by EPA discuss collection improvements in vehicle choice, routing, labor management, equipment maintenance, and so forth, in full detail.[4]

A fairly efficient collection system can be defined according to present practice. This average-to-good system would use two-man crews with the driver also collecting. In a single-family, detached housing pattern, it would require a twenty-yard packer truck, perform weekly collection of mixed refuse from curbside with a mix of cans and bags (or, preferably, bags only) and cost in the neighborhood of ten to fifteen dollars per ton. The crew would make two trips per day to a disposal site five to ten miles away. Management would be by the modified incentive system, where the crew is allowed to leave early if the route is finished, but is paid overtime when collection requires more than eight hours for the route. Only residential units would be included--major commercial areas would be the responsibility of the owner or collected by a special crew using stationary compactors and other equipment to increase productivity. Costs would be paid out of the general tax revenue or from user fees, often collected with the water bill. The operation could either be public, operated by the public works department, or contracted to a private firm for the whole community.[5]

The problems with this average operation are:

1. Rising costs;
2. Labor disputes;
3. No incentive for recycling;
4. Possible health problems with fly breeding in summer;
5. Spillage, primarily by dogs or in collection;
6. Unsanitary storage, particularly near apartments;
7. Contracting with private firms and making sure they perform acceptably;
8. Regulating public performance, particularly where small public health departments are attempting to regulate large public works departments.

Litter Collection

Litter collection and street cleaning are much more expensive than conventional collection on a per ton basis.[6] Street cleaners are expensive to operate, and require frequent maintenance. They are only able to operate when the streets are clear of parked cars, and are most effective in picking up large objects like leaves or cans.[7] Litter baskets reduce the amount of street litter, but their contents must be collected within the most densely used areas of the community, since those are where litter baskets should be installed. In many less dense areas, litter may best be left to property owners to pick up on a regular basis.

However, litter and other street wastes have important environmental impacts. Some of these were discussed in Section II: Parking Controls. There, it was shown that the fine particles in street wastes can have significant water pollution impacts, and that parking controls can greatly increase street sweeping effectiveness. Larger pieces of litter, though, can be equally important. The problems of unsightly streets are obvious, but in addition, garbage, dog feces, and trash provide food and shelter for flies and rats. Many street and building fires start from uncollected litter.[8] Leaves and paper can block storm drains, causing local flooding. Glass bottles and metal cans, which form the bulk of roadside litter, may cause injuries, particularly to children. Controlling street litter is an important environmental quality issue, and should be part of any community's solid waste management program. (See Section B.4 below)

Source Reduction

Per capita solid waste generation has risen continually since measurements started, probably because of the increased affluence and urbanization of the population.[9] The depletion of natural resources to make packaging materials and the discarding of papers and other household wastes is a serious national problem; local communities absorb part of the cost of this profligacy through the large volumes of waste which must be collected and disposed. They would benefit if waste production declined: landfills would last longer with less waste, and collection would be less expensive if source reduction occurred.

Reducing waste at the source is difficult, however. Consumers are willing to pay high prices for convenience, and regulatory changes affecting packaging practices must come from the states or the federal government. Some local bottle bans, for example, have been ruled unconstitutional because the states have not given local governments the necessary powers.[10] But, others have stood, and local support for state legislation is critical. In general, the problem faced by local communities is that of reducing waste at the source by merely encouraging changes in consumption, alternative methods of disposal, or recycling. Most local regulatory programs are not legally or administratively feasible at this time.

Processing and Disposal

The processing and disposal of solid waste generally only require ten to twenty percent of the solid waste budget, but are often responsible for a much larger fraction of the management problems. The most common difficulty is in finding a disposal site, particularly now that most states have set strict standards for landfills. Handling of hazardous wastes, sewage treatment sludges, or other types of waste besides the municipal collection can increase the difficulties. So can pressure from citizens to do some sort of recycling, particularly in areas where it will only increase costs.

Some of these problems are primarily technical, such as the definition of what is environmentally acceptable in a landfill site,[11] (see Table 38) or the design of a resource recovery plant. Others are social or political, such as convincing a community that a specific site will not affect surrounding property values, or that a regional landfill located in the community must be accepted. Some of the problems, though, can be partially solved using ordinances and local government powers, in conjunction with technical and political considerations.

Table 38

The Wide Range of Pollutant Levels in Leachate Composition

pH	4.9 - 8.4
Total Hardness, mg/l as $CaCO_3$	30 - 13,100
Total Alkalinity, mg/l as $CaCO_3$	100 - 20,805
Total Iron, mg/l	2 - 1,000
Sodium, mg/l	8 - 1,805
Potassium, mg/l	28 -3,770
Sulfate, mg/l	24 -1,220
Nitrate Nitrogen, mg/l as N	5 - 196
Ammonic Nitrogen, mg/l as N	0.2 - 1,106
Chemical Oxygen Demand (COD), mg/l	246 - 750,000
Biochemical Oxygen Demand (BOD 5), mg/l	5.9 - 920,000
Total Volatile Acids, mg/l CH_3COOH	<100 - 10,000
Total Dissolved Solids, mg/l	1,740 - 11,254

SOURCE: J.F. Hudson, et al., Evaluation of Policy-Related Research in the Field of Municipal Solid Waste Management, Report R74-56, Department of Civil Engineering, MIT, 1974.

The siting of processing plants or landfills is always difficult, particularly in urbanized areas where the site affects surrounding residents. Proper site design, including leachate and gas controls, buffer zones, and adequate traffic routes, can greatly decrease the direct impacts of the site, but cannot eliminate them completely.[12] Public education campaigns can answer citizen objections, but can never make the neighbors of the proposed site happy about it in advance, even with plans for conversion of the completed landfill into parks or other beneficial uses. The role of ordinances here is twofold: first, to use zoning and similar powers as an aid to site acquisition, rather than a hinderance; and, second, to insure that the site is operated acceptably, so that a model will be available to aid in acquiring the next site. In general, public uses such as landfills, fire stations, and other public buildings should be allowed in most areas of the community. The distribution of "noxious" facilities should be spread out, so that one neighborhood gets the landfill, one the sewage treatment plant, and one the alcoholism outreach center, but no area is faced with all the unwanted facilities. Options such as flexible zoning, which allow sites of public value to occur anywhere within a specified area, should be considered (See Section I). If provision is not made for site locations in the comprehensive plan and the zoning regulations, it may be impossible to find a site which is acceptable on all counts.

Public control should be placed over landfills, whether run by private firms or by the disposal agency. Public health standards have been set and enforced by a number of states, but there is generally room for local involvement in permitting, monitoring, and regulating. Local boards have responsibility over groundwater and surfacewater, both of which are affected by landfill. Public health agencies can have permitting authority for all landfills, including public ones, and can require performance bonds from the private operators.[13] Combined with an effective inspection program, analyzing leachate, runoff, and the general site condition, the result can be true sanitary landfills.

The local government can expect only a minor role in controlling the impacts of sewage sludge and hazardous wastes.[14] The technical issues of designing landfills for toxic materials, and of insuring that such landfills are properly operated, should be the responsibility of the state, since such sites generally serve a larger jurisdiction than that of the local government. However, local governments should have an understanding of the problems, and should be sensitive to the condition of the groundwater and general environment near such sites. If the sites are privately operated, permits should be required like any other landfill, so that there is a local interest in overseeing their impacts.

While the permits and siting problems for transfer stations, incinerators and resource recovery plants are slightly different, the issues are the same: such sites provide a public service, but they also have adverse local impacts, and should be regulated. Noise, traffic, and odors are more important for facilities than they are for landfills, however. Private facilities should properly be limited to industrial zones, since they are industries, processing raw materials into useful products.

When all else fails, most communities try to combine their landfill or facility siting procedures. This is the outgrowth of a long tradition of putting facilities on community boundaries, so that the impacts do not affect local voters, but instead those of the next town over. With interlocal agreements, one community generally tries to convince another to accept waste, for a suitable fee or other considerations. This seldom succeeds. The successful interlocal agreements come when a number of communities decide to save costs and siting requirements by finding a site on which they all can agree, and also working out a compensation procedure for sharing the burden. This works best for resource recovery facilities, where the site location problem is not as severe; it is least successful for landfills, but can work there, especially if the plan has phased sites impacting each of the communities over time. In any case, interlocal agreements take a great deal of care in planning, and require special arrangements for financing, authority, and sharing the burden. Most states are now attempting to promote or operate regional systems, primarily for resource recovery.

Besides these major facilities, local governments are also involved in processing solid waste through recycling. There are two models for community recycling programs: the separate collection model, and the recycling center model. Recycling centers are simple operations, where citizens voluntarily bring their waste to a central point and separate it into the valuable components (glass, sorted by color; aluminum and steel cans; newspapers and other high quality papers).[15] Municipal or volunteer labor then process the waste and transport it to users, who save money and energy by using the reclaimed materials. Program success can depend on whether the community will dedicate land; whether union or volunteer labor is required; and whether the funds are donated to a "good cause" or enter the general tax levy. Municipal participation, through low-level support for volunteer programs, and through the provision of some equipment and space, can be extremely effective.

The other option is to provide separate collection service for certain products (most commonly, newspapers). Technical details are easily available, but there are some significant legal issues.[16] If the papers are valuable, there is a tendency for scavengers to appear, and to collect the papers before the collection crews. This leads to questions about whether such scavengers should be allowed, and also whether they are stealing from either the homeowner or the community when they remove the "waste." Most communities have outlawed scavenging for this reason.[17] In at least one case, however, it was proposed that the scavengers be licensed by the community, and required to post a performance bond.[18] So long as the price for waste newspapers was sufficiently high, they would collect the waste at no cost to the community, and would be providing some savings in collection cost and landfill space. This program has not been implemented but appears promising.

OPTIONS FOR IMPROVEMENT

Improvements in Household Storage

Before the solid waste ever enters the "solid waste management system" it must be stored on the premises where it is generated. Acceptable storage systems range from traditional thirty-gallon metal cans to plastic or paper bags, or, for apartments, ten cubic yard containers or roll-offs with compactors attached. Injuries to collection personnel often result from old or overfull containers, so the municipality has a major interest in insuring safe and sanitary storage. And since solid waste fires, spillage litter, and fly-breeding are often the result of improper storage, there are important public health justifications for municipal regulatory actions to improve it.

For residential collection, this is fairly easy. A standard can be set as part of a comprehensive solid waste ordinance describing what sorts of containers are acceptable. For unacceptable permanent containers, such as old cans with split seams or without lids, a notice can be pasted on the can by the collectors stating that it must be replaced. If this is not done by the next collection, it can be treated as trash and collected; the resident will then need a new container for the next collection. For unacceptable disposal containers, such a paper shopping bags, the problem is more difficult. They should be collected, but, if the problem persists, an inspector should issue a violation notice to the resident, in a form similar to a parking ticket if possible. (It is worth lobbying for legislation allowing such citations.) These two procedures can help insure that the storage containers are of satisfactory quality. Provision of bags or containers in portions of the community may provide another option.

Insuring public health in multi-family housing areas is extremely difficult. Inspection programs can cite landlords and building owners, but the ability of such inspections to lead to cleanliness has not been proven. If the violator is a tenant, he is protected by anomymity. If the landlord is the violator, small fines and orders to improve will have little effect. For landlord-caused violations, as for other housing code problems, certificates of occupancy can be made contingent on inspections, though this is expensive.[19] A special housing court can also be a useful technique, although even it will fail if neither the tenants nor the landlord see an immediate incentive to keep areas clean and sanitary. Outside inspections of the practice are often satisfactory, and it would be possible to require permits for equipment, such as containers or compactors, used to haul, process, or transport wastes. The permits would allow annual inspection, not only of the equipment, but of the ways it is used.

The local government also has options related to the sorts of interior household storage that are allowed. Some communities have required the use of plastic or paper bags, with great success in reducing collection costs and potential for reduction in fly breeding, rats, and spillage.[20] However, plastic bags may impose an additional expense on householders, and may be subject to breaking or damage by dogs, particularly if the bags are too thin or filled over capacity. The expense problem can be mitigated by free distribution of plastic or Kraft-paper disposal bags in low income areas. In any case, communities should require that the National Sanitation Foundation standards for bags be met, to minimize spillage and injuries.

While not a true storage option, composting should also be considered here. Many communities do not allow composting of household waste, yet it can be healthy and environmentally sound.[21] The dangers of bacteria, virus, and insects do exist if the compost heap is not carefully used, but a permit program can easily be set up to provide for annual inspections by public health officials. The fee should be small, and the reductions in waste generation could be significant, particularly if consequent reductions in garbage allowed reduced collection frequency. Incentives to householders for composting would include lower solid waste collection costs (if individually assessed) and the availability of compost as a soil conditioner (see also "Improvements on On-Site Waste Management Systems" in Section IV).

Improved Collection Operations

The Environmental Protection Agency, the American Public Works Association, and other groups have been concerned with the efficiency and effectiveness of solid waste collection procedures. Collection accounts for the majority of solid waste management costs, usually between seventy and eighty-five percent, and improvements in collection efficiency may greatly reduce costs.[22] Many such improvements have been suggested: reductions in crew size, curb instead of backyard collection, improved vehicle design, well-planned collection routes, use of transfer stations to reduce long hauls, incentive systems for the crews, changes in collection frequency, combination of trash and garbage collection, injury reduction programs, conversions from public to private operation or vice versa, etc. All are well-documented in the literature about collection, and all may lead to cost savings or increases in productivity.[23] We will not attempt to review them all, but will concentrate on those that may have unrecognized environmental side effects.

Curbside pickup (as opposed to backyard collection) reduces the costs of collection by about fifty percent, on the average.[24] It means that crews do not have to enter private property, which reduces legal problems and saves fuel. However, it can lead to unsightly streets on collection day, and probably results in increased spillage by dogs. The cost savings are undoubtedly worthwhile in most communities, but curbside systems require that the waste be stored in tightly covered containers or heavy bags, and these storage standards must be enforced. Curbside pickup also requires that collection be performed on schedule, so that the waste is not left on the street longer than necessary; this is less important in backyard systems. In fact, it is probably desirable in curbside systems to have inspections to make sure that residents do not place the waste out too early, or leave the cans at the curb too long. It may also be important to have a set-out, set-back crew to aid elderly or infirm citizens.

Storage arrangements involving large wheeled carts have been developed for curbside collection in single-family areas.[25] The carts should contain a week's waste for a family, and are to be wheeled to the curb. They are high-impact plastic, have a guarantee, and have tight lids. If required by the community, they will help eliminate spillage and aesthetic problems with curbside collection. They are costly, and best suited to generally flat, suburban areas.

Changes in frequency may also affect the environmental impacts of solid waste collection. As might be expected, weekly collection costs less than twice-weekly collection (about twenty-five percent), but it may have other impacts.[26] In blighted areas, high collection frequencies reduce street litter and can improve the appearance of the area. In warm climates, twice-weekly collection may be required to inhibit fly breeding in the waste.[27] (An alternative is to require the use of plastic storage bags or well-designed containers like those described above.) More frequent collection may also make recycling easier, particularly in areas where storage space is limited. In general, though, weekly collection is acceptable, particularly if combined with stringent storage requirements.

Private or public operation has been a continuing issue in solid waste management. Private operations have generally been found to be less expensive, particularly in areas where the municipal system has had a monopoly for a long period.[28] However, private operations must be carefully contracted and regulated, with performance bonds, permits, and similar procedures to make sure that the work gets done acceptably. The incentive for the private operator is to cut costs wherever possible, and that will mean that the service will be the minimum acceptable to the community (as it should be for economic efficiency). The EPA Model Solid Waste Ordinance deals with the regulation of private firms in great detail, and is discussed in "Ordinances and Equipment" in this section.

Pricing of solid waste management is another issue of importance. Many systems use general tax revenue or support collection by a flat fee for service paid by all households. Both forms burden the poor proportionally more than the rich, the flat fee system being the more regressive of the two. In recent years, a number of communities have placed limits on the amount of waste collected per household, or have sold bags with special markings which are priced to cover collection costs.[29] In the latter arrangement, all wastes must be placed within a fee-paid bag (or have one attached), in order to be collected. In both approaches the idea is to increase the equity of collection pricing: it is fair to charge every household for the amount of waste it produces. Such a system has a serious drawback, however. For, in providing an incentive to reduce wastes placed out for collection, it may indirectly encourage littering or illicit dumping with harmful environmental effects. Free service for households with low-incomes can reduce this problem somewhat.

There are three ways residents can reduce their volume of waste: one is to pack things more tightly, for example by crushing cans and cartons. This may lead to increased density in the truck and landfill, and may have a positive effect. But it may also lead to over-filling containers and increased spillage. The second option is for households to increase their recycling, and thus reduce the amount of waste they produce. This too has a positive result. The third option, however, is for households to dispose of wastes privately: if procedures are provided for carrying the waste to the local landfill some residents may do so, but it is more likely that such disposal will involve littering, dumping waste in vacant lots, or illegal backyard burning. Any community experimenting with pricing mechanisms should monitor the amounts of waste collected, recycled, and picked up as litter. There is evidence that the volume of waste collected falls, but there is little information on whether the remainder is recycled, littered, or simply not generated.[30]

Each of the topics discussed above involves a major change in the collection service, and each has some side effects related to the type of service provided. The same is true for many of the other potential collection improvements, so careful analysis of the impacts of any change should be done before the change is implemented. The EPA ordinance contained below provides useful suggestions on the normal range of options; both legal and economic analysis should be applied to the alternatives listed above.

Recycling Incentives

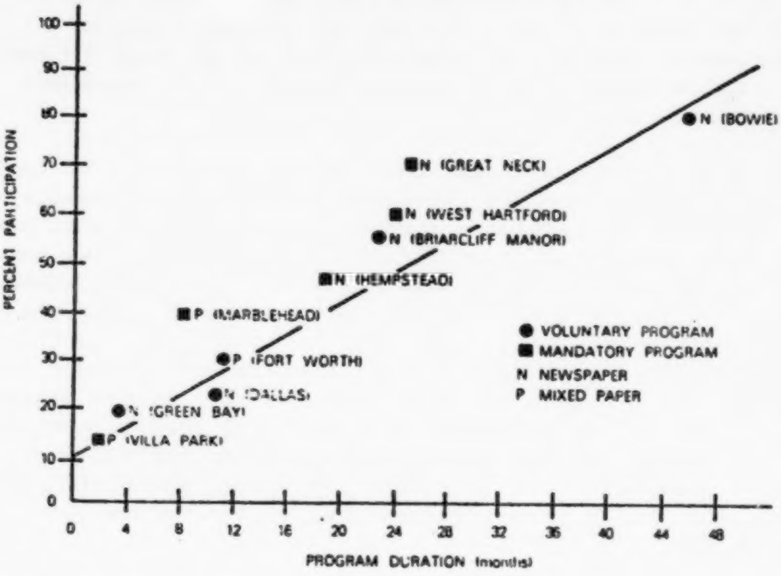
Local governments should support voluntary recycling programs to the extent of their ability. Not only does recycling aid national goals of reducing resource consumption, but it also can reduce the costs to local governments of solid waste collection and disposal. While most collection costs depend on the number of collection stops rather than the volume of wastes, recycling will at least reduce the number of hauls per day for the collection vehicles. More important, especially in urban areas, increased recycling will reduce the volume of landfill required each day, and increase the useful life of landfills. If sufficiently practiced, recycling, garbage grinders, use of bags for storage, and composting can reduce collection frequency for specific items to once/two weeks or even once/month. The result is large savings of manpower and equipment.

The basic issue here is how local governments can increase recycling, primarily through separation of valuable materials by the residents before collection (source separation). The easiest option is to set up a recycling center, probably using volunteer labor, that will accept materials from residents and sell the materials to secondary materials brokers. In most areas, this approach is likely to break even, or perhaps show a slight profit, if the materials include newspaper, glass, and metals. A large number of these programs presently exist, and more are formed whenever market prices for these materials are high.[31]

A more expensive approach is to collect recyclable materials on regular collection rounds, but to keep them separated.[32] Collection costs will rise, but a much greater volume of materials will be separated. Participation seems to depend on the length of time the operation has existed, and appears insensitive to whether separation is voluntary or "required" (see Figure 15). Designs are available for adding racks for the reclaimed materials (usually newspapers) to standard packer trucks.[33] Since newspapers generally form over ten percent of the volume of residential solid waste in urban areas, savings in landfill space will be significant.

Figure 15

Increase in Citizen Participation in Recycling Over Time



SOURCE: EPA

However, before any such programs are attempted, it is crucial to find a market for the reclaimed goods. A number of communities have been forced to landfill separated materials because they could not afford to sell them at the market price. The secondary materials market undergoes frequent price shifts, and the price paid for a material, such as Grade 2 newspaper, may range from \$25/ton at some periods to \$3/ton at others.[34] It is extremely important to find a user with a fairly constant demand, such as a roofing plant. The price will not be \$25 a ton, of course, but should be sufficient to stabilize the economics of the program. Ideally, the waste newspaper should be shipped to a user producing new newspaper to close the reuse cycle, but there are few such plants in existence at present.[35]

Newspaper and, to a lesser extent, glass are the most common materials recycled by municipalities, but cans (particularly aluminum cans) may have enough value to involve the private sector in recycling. Thus, while cans might be a valuable byproduct of a municipal recycling program, the local government should specialize on the "unwanted" glass and newspaper to achieve the highest overall rates of recycling and to insure that recycling is actually increased.

Litter Control

This brings us to the final way local communities can reduce pollution from solid waste: litter control. Litter laws are generally underenforced by the police--the "crime" seems so minor and insignificant that the effort involved in enforcing the law is too much bother. Even in cases that go to court, most are dismissed with only small fines: a $50 to $100 maximum fine is seldom enforced. Enforcement of litter regulations may have a major impact on urban environment, but the enforcement cost is too high to make it seem worthwhile. Enforcement of anti-litter ordinances is uncommon, except in special cases.

There are other ways to reduce littering, however, which can be implemented by the local government. One is the provision of litter baskets in commercial areas. The costs of providing and collecting from them is not large, particularly when compared with street sweeping costs for the same amount of material, and the effectiveness is high. One researcher showed that littering nearly doubled in areas without litter cans.[36] (see Table 39) Street sweeping and clean-ups can also reduce future littering. In the same study, it was shown that areas that were already dirty received about twice the amount of litter as clean areas, all else being equal. Street sweeping is expensive, but probably not as expensive as either rat control programs or special periodic cleanups. Street sweeping may also be partially subsidized by businessmen's associations in commercial areas, where the problems are largest. Any collections by street sweeping will also reduce water pollution (see Section III).

The final option for litter control is public involvement. Littering is much more common by people under eighteen years of age than people over eighteen (see Table 39), and programs in the schools may be effective in reducing the amount of littering. Keep America Beautiful, Inc. has a great deal of information on how to get people to stop littering.

Table 39

The Impact of Visual Environmental Quality on Littering

Percent of People who Litter:

	Clean Area	Dirty Area
Litter cans	15	33
No cans	34	51

Percent of People Under 18 who Litter:

	Clean Area	Dirty Area
Litter cans	59	77
No cans	77	95

SOURCE: Finnie, "Field Experiments in Litter Control."

The Keep America Beautiful approach involves an Action Research Model (ARM) which relates people's littering behavior to community norms. In a simple example, if people expect busboys to collect dishes in a cafeteria, they will leave the dishes on the tables. If most people get in the habit of busing their own trays, then almost everybody will do so. In many ways, the Keep America Beaufiful approach attempts to change from the first norm ("Somebody else is responsible") to the second ("I clean up after myself").[37] Other norms are also involved--those of the solid waste managers, who have the responsibility of running the litter control system; those of the politicians; and those of the people who stand by watching others litter without seeking to restrain them. (See Table 40).

Table 40

Common Litter Norms

LITTERERS:	It's OK to litter where litter already is.
	Its OK to litter where someone else is responsible for cleaning up.
	Its OK to litter in places where the individual has no sense of ownership for the area.
MANAGERS:	I've always run my operation this way.
	It's somebody else's responsibility.
	I'm only one, what I do won't make any difference.
VICTIMS:	Nobody else gives a damn, why should I?
	Those people (ghetto residents, sanitation workers, container manufacturers, fast food operators, other scapegoats) are responsible for this mess.
	You can't fight city hall.

SOURCE: Keep America Beautiful, Inc., ARM Final Report, New York: KAB, 1975.

In a number of cases, the Action Research Model has been applied to find those changes which will be most effective in changing the community norms to make littering unacceptable. There are a large number of possible approaches, but they generally require a citizen's committee to evaluate changes, a survey to establish norms, publicity, and some changes in the collection operation, at a minimum. Both the detailed changes and the results vary from community to community, but the public officials in all test communities have been very satisfied with the results and will continue the ARM approach, as developed into the "Clean Community System." Table 41 shows some of the results.

The appendix at the end of this section presents a litter control ordinance developed as one portion of the approach for one of the test communities. Keep America Beautiful, Inc. should be contacted for further details on implementing the ARM in a community.

Table 41

Measurements of Litter Accumulation In Clean Community System Communities

Community	Total Percentage Change in Litter	Percentage Change/ Year of Program	Date of Sample	Compared To
Charlotte, NC	-71.2	-32.8	4/76	2/74
Evansville, IN	-40.3	-48.4	5/76	7/75
Macon-Bibb Co., GA	-57.0	-31.3	2/76	4/74
Reno/Sparks, NV	-33.6	-36.7	3/76	4/75
Sioux Falls, SD	-50.9	-29.8	5-6/76	9/74
Tampa, FL	-73.0	-33.7	4/76	2/74

Processing and Disposal Technology

Solid waste interacts with other pollution problems, primarily through the way in which it is processed and disposed. The air pollution problems of incinerators are well known, as are the leachate effects from sanitary landfills too close to groundwater or unsuitable soils.[38] The air pollution and water pollution controls also generate large amounts of solid waste, primarily in the forms of sewage sludge and slurries from power plant scrubbers.[39] Municipalities generally do not have to worry about agricultural, mining, or industrial wastes, but they do have the responsibility for sewage sludge, and they should consider it in their planning. Since the biggest problem in solid waste management is often site acquisition for disposal, minimizing the number of disposal sites can be an important goal.

Alternatively, it may be desirable to have a large number of short-term landfills, each operating on a small site for a year. The burdens would be spread around the community and areas needing fill for park development would receive it. This has been suggested in the literature,[40] but has not been attempted in practice. While in most cases it will be best to minimize the number of sites, the option of increasing them in this manner should at least be considered.

One way to minimize disposal sites is to process the waste, and at present that generally means to build a recycling plant. However, recycling plants are expensive, largely untried, and have unknown costs and environmental impacts.[41] Though they are presently being implemented where conventional options seem unavailable, they are probably the long-term solution to the solid waste management problem.

There is, though, one important question related to recycling plant economics: if much of the value of the reclaimed materials comes from the metals and glass in solid waste, what effect do source separation programs have on plant economics?[46] For example, a plant which is supposed to operate for a net cost of $10/ton (after sales of reclaimed materials and fuel), may actually operate for a net cost of $12/ton to $15/ton if the metals and glass are not available. Since the community recycling programs and recycling plants are often operated by different agencies, coordination is required.

RATING THE OPTIONS

A large number of ways to improve solid waste management in local governments were mentioned in the preceding section. These options involved ways to change the standard storage-collection-disposal system to either consider outside factors, or to respond to changing conditions. The major options discussed were:

1. Improved residential storage containers
2. Inspection of containers during collection
3. Inspection of containers at other times
4. Permits for household composting
5. Private or public management
6. Changing collection location
7. Changing collection frequency
8. Pricing for each can collected
9. Operating recycling centers
10. Separate collection of materials to be recycled
11. Enforcement of litter ordinances
12. Providing litter baskets
13. Using the KAB Clean Community System to reduce littering.

There are four factors which must be considered for each of these suggestions: what difference they will make; how much they will cost local government; how much they will burden local residents; and how they can be implemented. Table 42 gives a general rating for each of the options ranked in order of declining effectiveness; detailed discussions are given in the sections below.

Effectiveness of the Options

This section is concerned with the environmental benefits and costs of the options mentioned above. Each has certain characteristics which influence whether it is beneficial or harmful, and how much difference it makes.

Changes in collection service--decreases in frequency and change from household to curbside collection--have a minor effect if combined with satisfactory storage. Flies breed in about five days, so weekly collection will allow fly breeding if containers are open or uncovered. If plastic bags or well-designed cans are used effectively, however, this impact will be minimal, assuming good performance by the collectors. The same is true for spillage at the curb--with good containers, it will be minimal; with poor containers, it will be a major problem.[43]

Table 42

EVALUATION OF MANAGEMENT IMPROVEMENTS

OPTION	EFFECTIVENESS	COST TO GOVERNMENT	BURDEN ON RESIDENT	IMPLEMENTATION PROBLEMS
Separate Collection of Recyclable Materials	excellent	moderate-high	low	easy
KAB-ARM for Litter	very good	moderate-high	change in values	fairly easy
Improved Storage Containers	very good	savings possible	expensive	difficult
Inspection during Collection	very good	near zero	zero except for violators	easy
Recycling Centers	good	low	high	easy
Inspection Outside Collection	moderate	high	minimal	easy
Litter Baskets	moderate	high	--	easy
Residential Composting	moderate	paid by permit	--	easy
Litter Enforcement	low	high	--	difficult
Change Location of Collection to Curbside	moderate-low	savings	more effort	variable
Private/Public Operations	variable	private less expensive	low	difficult to shift
Reduce Frequency of Collection	variable	savings	less convenient	variable
Pricing by Can or Bag	unknown	may provide net income	incentive to litter	easy
Improved Street Sweeping	See Chapter II			

The use of proper storage containers may be the most important change a community can make in its solid waste management. Requiring thick plastic or paper bags, which meet NSF standards, can reduce the impacts of storage and collection considerably if enforced. Provision of permanent containers by the community can have a similar effect and may, in suitable areas, even reduce total costs. In any case, inspection by the collectors to make sure the containers are suitable will be important, and the easiest way is to supply them with stickers to place on unsatisfactory containers; any container found with a sticker at the next collection is considered trash. With sufficient public education before the rule is implementd, complaints can be reduced to an acceptable level.

Inspection outside the collection process is probably just as important, since spillage and unsanitary conditions at apartments or commercial sites is a continuing problem. Probably over half of urban fires start in trash,[44] and waste handling in large buildings is particularly shoddy: once the waste leaves the office or apartment, it is often ignored. Similar inspections of residential composting, residential incinerators, and other waste handling procedures can be implemented by requiring permits whose cost covers the inspection fee.

Pricing by the can attempts to increase the equity of the solid waste management system, but may as a result give people incentives to litter, especially if alternatives are not available for low income households.[45]

Three types of recycling programs can be effective on the local level. One is the recycling processing plant, which probably uses the waste most effectively, but should be looked at primarily as a method of waste disposal for the community. The other two require source separation; of these, a system that collects directly from households will be more effective than a system requiring residents to make their own waste to a recycling center. Even paying centers are often less effective than separate collection, resulting in twenty percent less participation and fifty percent less waste in one analysis.[46] Publicity, particularly personal contact, greatly increases the amount of waste separated, and large houses with sufficient storage space are more likely to recycle materials than people in apartments or overcrowded dwellings.[47]

The most effective way to reduce litter, both on the streets and in vacant lots, is to take a comprehensive approach like the ARM developed by Keep America Beautiful, Inc.[48] Provision of litter baskets, improved collection procedures, public education campaigns, and litter ordinance enforcement are all pieces of the process, but effective litter control really requires that the pieces be put together, and the KAB approach appears to be the best available.

Cost to the Government

Several of the proposed improvements provide savings to the local government. Conversion from twice-weekly to weekly collection saves about twenty-five percent of collection costs, and changes in location save about fifty percent. Requiring standardized or disposable storage containers may also lead to savings: bags reduce costs about thirty-five percent for collection, and standardized containers without mechanized pickup may also reduce costs somewhat. Conversion to private collection can reduce costs because of higher productivity, but only if the contract is with a local government: individual contracting with private firms is likely to lead to major problems in assigning responsibility for unsatisfactory service, and overlapping routes will greatly reduce efficiency.[49]

Inspection programs related to household storage will have very low costs, since they will be integrated with the collection operation. Other inspection programs of waste handling equipment, storage areas, and composting can be self-sustaining through permit fees for yearly operations.

Recycling centers can operate at about $16/ton if volunteer labor is used.[50] This must be compared to the prices for the reclaimed materials, and to the expected savings in collection and landfill costs, which are different for each community.

Separate collection program costs are more difficult to estimate. Racks for installation under trucks for newspaper collection cost about $200/truck, and the whole program might increase collection time by about fifteen percent, with fifty percent participation or more.[51] Again, these costs must be compared to the value of the paper and the savings in landfill space. It is extremely important to get long-term agreements on a paper price; otherwise shifts in the paper market will greatly change the expected cost of the program. In any case, both recycling centers and separate collection are close to break-even operations, in most instances.

The costs of litter programs are more questionnable. Community litter baskets in commercial areas can generally be supported by collections from nearby businesses, especially if the baskets display advertising. Collection from the baskets, though, is liable to cost $30/ton or more. The full ARM program cost $30,000 in Macon, Georgia, an area of 143,000 people, for administration and education only (ARM tends to use such funds as seed money to convince government departments, citizens, and businesses to make the necessary changes). Macon, for example, hired three inspectors, remodeled the public works building, and convinced businessmen to install over two-hundred litter containers. The total costs of litter control in a comprehensive system like this are high, but the seed money to get the program started is fairly small. If the program is not a success, then the later costs will not be incurred.

Burdens on the Residents and Community

Changes in collection systems that reduce government effort generally require larger portions of the cost to be paid by citizens. Curbside collection requires that the resident move his own waste to the curb, and this may be difficult for the elderly. Decreased collection frequency means that the resident must store twice the amount of waste, which involves expenses in buying containers, etc. Pricing by the can means that residents will do extra work to reduce the volume of waste, and gives them an incentive to find alternate means of disposal. Private collection may increase productivity and reduce all costs, but requirements for bags or standardized containers will mean large expenses for residents--$.05 per bag, on the average, or perhaps $10/household/year. Inspection and permit systems will require that permit fees be paid, perhaps something on the order of $25/ permit for apartments or commercial structures, and $5/permit for household compost piles on a yearly basis.

Recycling centers impose high burdens on community residents. The travel required to transport wastes is expensive, and the storage space required in each house could be used for something else. The burdens of separate collection programs are much lower: only separating and bundling the materials. Of course, recycling centers may pay for aluminum, perhaps even enough to make residents' trips profitable. Litter programs impose no burdens on residents, except for violaters.

The main burdens to communities as a whole, then, come from extra effort that residents must undertake to handle their wastes as collection service is cut back. These burdens are generally not high for the average household, but special provisions may be necessary for certain groups (the poor, the elderly, etc.).

Implementation of Controls

Many of the improvements suggested are expected to be easy to implement, to the extent that any change in the solid waste system can even be called "easy." If communities can be convinced of their value, then all of the litter controls, recycling, and inspection programs can be implemented with little difficulty. Legislation in the form of litter or solid waste ordinances will be required in many cases, and money to cover the government costs will also be required. However, the primary difficulty is in convincing people of the value of the approach; there are no vested interests aligned against the programs, and there are no requirements for special enabling legislation.

The situation is different for major changes in the collection service. Often people have had their waste collected from a location on a set of days at a given price for a long time, and any change in that (even something as simple as combining refuse and garbage) will meet with resistance. Still, the arguments for curbside collection and weekly frequency are strong ones, especially if the community can improve service with the expected savings. The same problem exists with requiring bags--the government savings are large, but there are costs to the householders; combinations of strategies may make it possible to reduce citizen resistance, by making a comprehensive change for the better in collection services.[52]

Conversion to private collection will require passing a solid waste ordinance similar to the one developed by EPA, and will meet with extreme resistance from employees, even if a no-fire policy is used, as is desirable. Large amounts of data on expected savings will be required because many people will wish to keep the public agency in operation; facts are the only defense. An education campaign, advertisements, or other political approaches may be necessary.

Enforcement of litter regulations is probably the most difficult of all the suggested improvements to implement. Instead of an arrest, a ticket for litter violations, perhaps on the order of five dollars, would seem likely to be effective, and might be used by police. In theory, exorbitant fines sound good, but if the fines are never enforced, they are meaningless. Thus, a smaller fine used more often would be an improvement. For this strategy there would probably have to be an enabling act allowing the procecure. At the least, a municipal ordinance would be required.

ORDINANCES AND EQUIPMENT

This section is intended primarily for reference. Many of the suggestions for improving solid waste management made above require special legislation, special equipment, or special technical knowledge before they can be implemented; this section attempts to provide some guidance to those sources.

Equipment and Standards

Most solid waste management systems require significant amounts of equipment. Trucks, containers, processing plants, litter boxes, landfill liners, paper balers, and so forth must all be bought by householders or local governments. There are good guides available for some types of equipment; for others, it is necessary to contact people already working in the field to get the necessary information. Probably the most valuable source of data on large equipment is the Waste Equipment Manufacturer's Institute, which has produced standards for trucks, storage devices, and other related pieces of equipment.[53] As secondary sources, the American Public Works Association and EPA are valuable. The American Public Works Association has recently finished a study of street sweepers, analyzing effectiveness, cost, and maintenance requirements.[54] EPA, APWA, and others have been involved in the analysis of which types of collection equipment are most effective for various needs.[55] The National Sanitation Foundation has developed standards for paper and plastic refuse bags,[56] and EPA has required similar standards.[57] *Consumer Reports* has also rated bags for trash.[58] Household compactors have been analyzed in a study for the City of Atlanta, Georgia,[59] and tests have been performed on large permanent plastic containers for Scottsdale, Arizona.[60] *Solid Waste Management* magazine provides a yearly equipment buyer's guide, and may be valuable.[61]

Any of the organizations described above--WEMI, APWA, NSF or EPA--will be happy to respond to questions about various categories of equipment and standards for them. To get detailed information on performance, it may be necessary to contact someone who owns the type of equipment of interest.

Design Information

The design of solid waste management systems, whether for collection, recycling, or disposal, is a complicated problem. Engineering, economics, public administration, and politics all have important inputs toward designing how the system should operate. Some sources of guidance are as follows.

For collection, two books are predominant. *The Decision Maker's Guide to Solid Waste Management*, by the Office of Solid Waste Management Programs at EPA, considers all the basic choices for collection systems, and attempts to provide information on the trade-offs faced in each choice, with recommendations were appropriate.[62] Solid Waste Collection Practice, by the Institute of Solid Wastes of the American Public Works Association is a detailed description of current practice among member communities.[63] It describes how things are actually being done, and attempts to establish the best practice.

In addition, both organizations provide some measure of technical support, and there are other trade organizations which will help. The National Solid Waste Management Association represents the private collection companies, who collect most of the solid waste nationally (and probably about fifty percent of residential waste). The Government Refuse Collection and Disposal Association is active in promoting acceptable solid waste management, and is based in the Los Angeles area.[64]

Recycling programs have been the subject of much less interest, at least as measured by the number of handbooks. The National Association of Recycling Industries may provide some information, particularly about markets for reclaimed materials, and the National Center for Resource Recovery will also help. Compost Science, the Journal of Waste Recycling, has printed a few how-to-do-it articles on recycling in communities; EPA has developed analyses of existing programs, and a guide to them. The Decision Maker's Guide also provides useful data on setting up separate collection programs, though less on the recycling center approach. The major container producers and bottlers have had a large interest in recycling programs and many have material to distribute.[65]

The amount of information on processing and disposal is continually rising. Sanitary Landfill Design and Operation, an EPA publication, is valuable but may become outdated if leachate standards are imposed. Sanitary Landfill, a manual by the American Society of Civil Engineers,[66] has been recently revised and expanded, and is an excellent source. For processing equipment, changing costs, environmental regulations, and successes and failures in existing plants make it difficult to get up-to-date information on any system. The National Center for Resource Recovery is one source, but it is necessary to have the services of consultants knowledgeable in the field before making major decisions. There are likely to be a number of communities incurring high costs because of poorly designed resource recovery plants; any technical knowledge which can avoid that should be sought.[67]

Ordinances

Two ordinances are included in this section. The first is the litter ordinance developed in Charlotte, North Carolina, as part of the ARM Litter Reduction Program, and it is followed by the Model Solid Waste Ordinance developed by EPA. The Charlotte ordinance is actually a general solid waste ordinance, but is particularly concerned with reducing litter and spillage in the storage and collection process. Its goal is a cleaner city, and it may aid in meeting these goals.[68]

The new EPA Model Solid Waste Ordinance is probably the first model ordinance developed in the field. It provides for control of storage, permits and regulation of collection and disposal, and administrative procedures.

One reason for the lack of past ordinances in this area is the great municipal involvement in the problem: as long as the community was handling all waste, ordinances were often viewed as unnecessary roadblocks in getting the job done.

The main thrust of the EPA ordinance is the procedures involved in contracting for waste services and in regulating private companies involved in solid waste management. Traditionally, these companies were small operations controlled in a fairly informal manner. Within the past decade, though, they have grown considerably, and formal procedures for contracting with them and regulating them are necessary. While these procedures do not have any direct environmental benefit, careful regulation will insure that the collection and disposal processes are carried out without any major harm to the environment.

The EPA model ordinance has a variety of drafting problems (e.g., note the multitude of definitions, many of which may well need to be modified to conform to existing local law). The model also attempts to create a rather complicated system, and in so doing, may well lose the thread of clarity for the layman. Despite these shortcomings, the ordinance is broad, and addresses most, if not all, of the issues a community would normally face in managing its solid waste program. It can be expected that the ordinance will be heavily modified to meet local needs and concerns, and to conform with existing local practice. In some ways, it is not a model for adoption by local governments, but rather a goal toward which they should strive.

For specific purposes, it may also be useful to look at EPA's Digest of Selected Solid Waste Management Ordinances or at the authority available in various states for regulation.[69]

Appendix VII-1

(APPENDIX "B")

AMENDING CHAPTER 10,
ARTICLES I and II

ORDINANCE _____

AN ORDINANCE AMENDING CHAPTER 10 OF THE CODE OF THE CITY OF CHARLOTTE

BE IT ORDAINED by the City Council of the City of Charlotte, North Carolina that:

Section I. Chapter 10 is hereby amended by the deletion of Sections 10-8 through and including Section 10-10 of Article I and Sections 10-13 through and including Section 10-16 of Article II in their entirety and substituting the following in lieu thereof:

"ARTICLE II.

COLLECTION AND DISPOSAL OF WASTE MATTER

This article shall be known and may be cited as the "Litter Control Ordinance."

Sec. 10-8. In general.

It shall be unlawful for any person to trespass on the rights of another through the neglect of property by causing or allowing unsightly litter, foul odor, or potentially dangerous devices to remain on or emanate from the property, or to discard, abandon, or cause such on public property or other's private property.

Sec. 10-9. Definitions.

For the purposes of this article, the following terms, phrases, words and their derivatives shall have the meaning given herein. When not inconsistent with the context, words used in the present tense include the future, words in the plural number include singular number, and words in the singular number include the plural number. The word "shall" is always mandatory and not merely directory.

The following definitions shall apply in the interpretation and the enforcement of this article:

Reproduced from
best available copy.

(1) "Building materials" means any material such as lumber, brick, plaster, gutters, or other substances accumulated as a result of repairs or additions to existing buildings, construction of new buildings, or demolition of existing structures.

(2) "Bulk container" means a metal container of not less than six cubic yards nor larger than eight cubic yards, made of water-tight construction with doors opening on two sides and top, and constructed so that it can be emptied mechanically by specially equipped truck. Containers shall be kept covered at all times. Hereinafter upon effective date of this section, all new bulk containers shall meet these specifications.

(3) "Business trash" means any waste accumulation of dust, paper and cardboard, excelsior, rags or other accumulations, other than garbage or household trash, which are usually attendant to the operation of stores, offices and similar businesses.

(4) "Central business district" means the section of the City bounded by Morehead Street on the south, the tracks of the Southern Railway on the west, Ninth Street on the north, and McDowell Street on the east.

(5) "City" means the City of Charlotte.

(6) "Commercial establishment" means any retail, manufacturing, wholesale, institutional, religious, governmental, or other non-residential establishment at which garbage or trash may be generated.

(7) "Detachable container" means a unit varying in capacity between 15 cubic yards and 40 cubic yards which is used for collecting, storing, and transporting building materials, business trash, industrial waste, hazardous refuse, refuse, or yard trash. The unit may or may not use an auxiliary stationary packing mechanism for compaction of materials into the container and may be of the open or enclosed variety. The distinguishing feature of the detachable container is that it is picked up by a specially equipped truck and becomes an integral part of the truck for transporting the waste materials to the disposal site.

(8) "Garbage" means the by-product of animal or vegetable foodstuffs resulting from the handling, preparation, cooking and consumption of food, or other matter which is subject to decomposition, decay, putrefaction or the generation of noxious or offensive gases or odors, or which during or after decay, may serve as breeding or feeding material for flies, insects or animals.

(9) "Hazardous refuse" means materials such as poison, acids, caustics, chemicals, infected materials, offal, fecal matter, and explosives.

(10) "Household trash" means every waste accumulation of paper, sweepings, dust, rags, bottles, cans or other matter of any kind, other than garbage, which is usually attendant to housekeeping.

(11) "Industrial waste" means all waste, including solids, semi-solids, sludges, and liquids, created by factories, processing plants or other manufacturing enterprises.

(12) "Litter" means garbage, refuse, waste materials or any other discarded, used or unconsumed substance which is not handled as specified herein.

(13) "Loading and unloading area" means any stream, river or lakeside or land dock, space or area used by any moving vehicle for the purpose of receiving, shipping and transporting goods, wares, commodities and persons.

(14) "Multiple residential unit" means any duplex, apartment, group of apartments, or condominium used for dwelling places of more than one family.

(15) "Person" means any individual, firm, company, corporation or association.

(16) "Portable packing unit" means a metal container not exceeding 4,500 pounds gross weight with a four (4) to six (6) cubic yard capacity that contains a packing mechanism and an internal or external power unit.

(17) "Refuse" means solid waste accumulations consisting of garbage, household trash, yard trash, and business trash as herein defined.

(18) "Refuse receptacle" means a metal or plastic container for refuse, of substantial construction, with tight-fitting lids and provided with wheels and/or handles sufficient for safe and convenient handling. Such receptacles shall have a capacity of not less than ten (10) gallons nor more than thirty-two (32) gallons and shall be kept in serviceable condition at all times. Plastic containers shall meet standards set by the Society of Plastic Engineers.

(19) "Single residential unit" means any dwelling place occupied by one family.

(20) "Small dead animals" means cats, dogs, small household pets, and other animals of similar size.

(21) "Tree and shrubbery trimmings" means waste accumulation of tree branches, tree limbs, parts of trees, bushes, shrubbery, cuttings or clipping, or other usually created as refuse in the case of trees or bushes.

(22) "Yard trash" means waste accumulation of lawn, grass or shrubbery cuttings or clippings and dry leaf rakings, free of dirt, rocks, large branches and bulky or noncombustible material.

(23) "Yard trash containers" means either refuse receptacles or two-ply kraft paper bags meeting the standards set for refuse sacks by the Technical Association of Pulp and Paper Industry and polyethelyne plastic bags meeting the standards set for trash bags by the Society of Plastic Engineers. Such containers shall be in good and serviceable condition and of such shape, size and weight that, when full, they are capable of being safely handled by one man. Paper or plastic bags shall be closed by a tight sealing method of suitable type, such as drawstring, wire tie, or multiple folds. Containers shall be kept covered or closed at all times.

Section 10-10. Administration and enforcement.

The administration and enforcement of the provisions of this article shall be the duty of the Department of Public Works.

Section 10-11. Receptacles and containers required.

It shall be required of every person in possession, charge or control of any place in or from which building materials, business trash, garbage, household trash, industrial waste, tree and shrubbery trimmings and yard trash is accumulated or produced to provide and at all times to keep in a suitable place readily accessible to the City collection crews or private collection agencies, adequate and suitable receptacles and containers capable of holding all such waste materials which would ordinarily accumulate between the times of successive collections. The Department of Public Works is designated as the agency to determine the quantity and location of said receptacles and to determine whether said receptacles and containers are serviceable.

Section 10-12. Receptacles and containers to be safe.

All receptacles and containers as required hereunder shall be of safe construction and design and shall be maintained in good and serviceable condition at all times. Any receptacles or containers which do not conform to the provisions of this article, or which have ragged or sharp edges or any other defects likely to hamper or injure the person collecting the contents thereof or the public generally, shall be promptly replaced upon notice. If said container(s), after proper notice, has not been replaced, the Department of Public Works shall have the authority to remove said container(s) as refuse.

Section 10-13. Pre-collection practices.

(a) Refuse. All refuse shall be placed and maintained in containers as specified herein. All containers shall be kept covered at all times with tight-fitting covers.

(b) Garbage. All garbage being placed in containers for collection shall have drained from it all free liquid, and shall be wrapped, bagged, or enclosed in paper or plastic material.

(c) Household trash. All household trash shall be drained of all liquids prior to its deposit in refuse receptacles. Household trash may be combined with garbage or yard trash. Any items of household trash which are too large for receptacles and cannot be reduced to a size which can be placed in a receptacle may be placed with tree and shrubbery trimmings no earlier than noon on the day next preceding the collection date for such material, provided such items are covered or secured so as to avoid unsightly litter condition.

(d) Dangerous trash items. All dangerous trash items, and all waste material of an injurious nature, such as broken glass, light bulbs, sharp pieces of metal, fluorescent tubes, and television tubes, shall be securely wrapped to prevent injury to the collection crews.

(e) Hazardous refuse and building materials. No hazardous refuse or building materials shall be placed in any receptacle used for collection by the City, nor shall the same be collected by the City.

(f) Yard trash. Yard trash may be stored for collection in suitable receptacles and containers as described in this article. The contents of such receptacles or containers shall not extend above the top of rim thereof, and shall be contained by tight-fitting lids or sealed enclosure to prevent the carrying or depositing thereof by the elements upon any street, sidewalk, or public or private property. Receptacles and containers of yard trash shall be placed at curbside for collection no earlier than noon on the day next preceding the collection date.

(g) Tree and shrubbery trimmings. Tree and shrubbery trimmings placed in refuse receptacles shall be collected by the City when placed at curbside no earlier than noon of the day next preceding collection. No tree trunks, branches, limbs, or shrubbery larger than four (4) inches in diameter, longer than five (5) feet or heavier than seventy-five (75) pounds shall be collected by the City. Tree and shrubbery limbs shall have protruding branches trimmed and must be neatly stacked and placed in an orderly manner at curbside. Unless such branches or limbs are of a size not to be blown about and scattered by the elements, they shall be effectively tied so as to avoid wind-driven debris and unsightly litter conditions. Tree and shrubbery branches, limbs and trimmings cut by landscape or tree service contractors or other commercial workmen or resulting from land being cleared shall not be collected by the City. Thorny vegetation shall be placed near the curb in small neat piles.

(h) Leaves. Leaves shall be contained in refuse receptacles or yard trash containers and placed for collection at curbside. From October fifteenth through January fifteenth, loose leaves may also be placed for collection in this location. At no other time or location will loose piles of leaves be collected by the City.

(i) Special collection of household furniture and appliances. Upon request, the City shall collect normal household discarded furniture and appliances, including sofas, chairs, beds, refrigerators, washers, dryers, hot water heaters, and similar items, but not including furnances. Persons requesting this service shall be notified by the Department of Public Works as to the date collection will occur. Items for collection shall be placed at curbside no earlier than noon on the day next preceding the scheduled collection. This service shall be available to residential areas only.

Section 10-14. Storing of refuse and trash.

All accumulations of refuse and trash shall be stored or placed for collection in accordance with the following provisions:

(a) Public streets and private property. No person shall place any accumulations of refuse and trash in any street, median strip, alley, or other public place of travel, nor upon any private property except as stated herein.

(b) Blockage of storm drains. No person shall place any refuse, trash, refuse receptacles or containers on, upon or over any storm drain, or so close thereto as to be drawn by the elements into same.

(c) Unauthorized accumulations. Any unauthorized accumulation of refuse or trash items on any lot, property, premises, public street, alley or other public or private place is hereby declared to be a public nuisance and is prohibited. Failure of owner or occupant to remove and correct any such unauthorized accumulation of refuse shall be deemed a violation of this article.

(d) Junk. It shall be unlawful for any person to place or leave outside any building or dwelling except as specified under Section 10-13(i) any dilapidated furniture, appliance, machinery, equipment, building material, or other item which is either in a wholly or partially rusted, wrecked, junked, dismantled or inoperative condition, and which is not completely enclosed within a building or dwelling. Any such item or items which remain on the property of the occupant for a period of ten (10) days after notice of violation of this section shall be presumed to be abandoned and subject to being removed from the property by the City without further notice. This shall not apply to authorized junk dealers or establishments engaged in the repair, rebuilding, reconditioning, or salvaging of equipment.

(e) Appliances. It shall be unlawful for any person to leave outside any building in a place accessible to children any appliance, refrigerator or other container of any kind which has an airtight snap lock or similar device without first removing the lock or door from said appliance, refrigerator, or container. This law shall not apply to any appliance, refrigerator or container which has been placed on or adjacent to the rear of the building and is crated, strapped or locked to such an extent that it is impossible for a child to obtain access to any airtight compartment thereof.

Reproduced from
best available copy.

Section 10-15. Scattering of refuse and littering prohibited.

(a) It shall be unlawful for any person to: (1) scatter refuse about or litter any public or private street or area or place; (2) cast, throw, place, sweep or deposit anywhere within the City any refuse or trash in such a manner that it may be carried or deposited by the elements upon any street, sidewalk, alley, sewer, parkway or other public place or into any occupied or unoccupied premises within the City; (3) throw or deposit any refuse, trash or debris in any stream or body of water.

(b) It shall be unlawful for any vehicle transporting loose materials within the City to transport same without suitable covers. This section shall not apply to the transportation of poultry or livestock or silage or other feed grain used in the feeding of poultry or livestock.

(c) In addition to other remedies, any person arriving at the City landfill and operating an uncovered truck in violation of (b) above shall be allowed access to said landfill only after being issued a notice of violation.

Section 10-16. Commercial establishments.

All commercial establishments shall store their refuse in containers as specified herein so as to eliminate wind-driven debris and unsightly litter in and about their establishments. Approved methods of containerization include refuse receptacles, bulk containers, and detachable containers. The number of containers necessary for each commercial establishment shall be as required to maintain a clean, neat, sanitary premises as directed by the Department of Public Works. Spillage and overflow shall be immediately cleaned up when and as it occurs by said establishment.

Section 10-17. Loading and unloading areas.

All loading and unloading areas shall be provided with refuse receptacles for loose debris, paper, packaging materials and other trash. The number of containers necessary for each area shall be as required to maintain a clean, neat and sanitary premises as directed by the Department of Public Works.

Section 10-18. Parking lots.

(a) Obligation to furnish receptacles. All parking lots and establishments with parking lots shall provide refuse receptacles distributed within the parking area. The Department of Public Works shall have the authority to determine the number of receptacles necessary to provide proper containerization. Such receptacles shall be weighted or attached to the ground as necessary to prevent spillage. It shall be the responsibility of the owner or the manager of the parking lot to collect the refuse and trash deposited in such containers and store this material in an approved location as hereinabove defined.

(b) Obligation to use receptacles. It shall be the obligation of all persons using parking areas to use such refuse receptacles or containers as hereinabove provided for the purposes intended, and it shall be unlawful for any person or persons to dump, scatter, or throw upon any such parking lot, any refuse, garbage, or trash of any kind.

Section 10-19. Construction sites and demolition sites.

All construction and demolition contractors shall provide on-site refuse receptacles, bulk containers, or detachable containers for loose debris, paper, building material waste, scrap building materials, and other trash produced by those working on the site. All such materials shall be containerized by the end of each day, and the site shall be kept in a reasonably clean and litter-free condition. The number of refuse receptacles, bulk containers, or detachable containers shall be determined by the size of the job. Dirt, mud, construction materials or other debris deposited upon any public or private property as a result of construction or demolition shall be immediately removed by the contractor. Construction sites shall be kept clean and orderly at all times. In addition to any other remedy, the Community Improvement Division is hereby empowered to issue a civil citation to a violator of this Section and in said citation shall assess a penalty of $50.00 and each and every day during which a violation occurs shall be a separate and distinct offense.

Section 10-20. Points of collection.

Refuse containers shall be placed for collection at ground level on the property and with access without the need for walking or carrying a refuse container over, under or around some yard or property obstacle. No refuse shall be collected where refuse containers cannot be reached by sanitation personnel without unlocking or opening a door, gate or any similar obstacle, encountering a dog, or otherwise being denied reasonable access by parked vehicles, yard tools and equipment, or other similar objects. No refuse receptacles or containers shall be stored in front of a home or in front of the building line closest to the street. The Department of Public Works shall have the authority to determine the proper receptacle or container location on private property.

Section 10-21. Sunken receptacles.

Refuse contained in sunken or underground receptacles will not be collected by the City.

Section 10-22. Collection practices.

(a) Residential. Garbage and household trash accumulated by residences shall be collected two (2) times each week in the backyard of said residences. Such collections shall be limited to a maximum of three (3) refuse receptacles or a total capacity of sixty-four (64) gallons per collection. Oversize household trash, yard trash, and tree and shrubbery trimmings shall be collected one (1) time each week at curbside as specified herein. Service will be on regularly scheduled days except weekends. During weeks in which there is an official holiday, there will be no curbside collection.

(b) Commercial establisheents. Service to commercial establishments shall be two (2) times each week, except that collections in the central business district shall be three (3) times each. Such collections shall be limited to a maximum of eight (8) refuse receptacles or one (1) bulk container per collection.

(c) Bulk container. Any commercial establishment that furnishes and maintains a bulk container suitable for handling by City equipment will be serviced by the City as herein stated, provided that said container shall be sufficient size as specified and be approved for collection. All new bulk containers approved for service by the City shall be either portable packing units or bulk containers. Said containers and units shall at all times be kept in a place easily accessible to City equipment, and shall at all times be kept clean, neat, painted, and in good state of repair. Service shall be discontinued to establishments failing to maintain containers and units appropriately. Establishments utilizing portable packing units or bulk containers shall be responsible for preparing said containers and units for service; no service shall be given those establishments permitting objects, obstructions, or vehicles to hinder in any way the servicing of the said container or unit. Cleaning up spilled materials shall be the responsibility of the property owner or occupant.

(d) Industrial waste. Industrial waste shall be collected, removed and disposed of by the operator of the factory, plant or enterprise creating or causing same.

(e) Hazardous refuse. No hazardous refuse shall be placed in any receptacle used for collection of refuse by the city.

(f) Dead animals. Small dead animals will be collected by the City during operating hours of the city landfill provided the body is in a location accessible to the collector. Owners of large dead animals shall be responsible for their removal and disposal.

(g) Building materials. The City shall not be responsible for the collecting or hauling of building material originating from private property preliminary to, during or subsequent to the construction of new buildings, alterations or additions to existing buildings of whatsoever type or from demolition of existing structures. Such material shall be removed by the owner of the property or by the contractor. No new certificate of occupancy shall be issued until such material has been removed by the owner or contractor.

(h) Hazardous or liquid waste or highly combustible industrial waste shall not be disposed of in the City's landfills.

Section 10-23. Post collection practices.

Refuse receptacles placed at curbside for collection shall be removed from curbside by midnight on the day of collection.

Section 10-24. Special refuse disposal problems.

(a) Contagious disease refuse. The removal of clothing, bedding or other refuse from homes or other places where highly infectious diseases have prevailed shall be performed under the supervision and direction of the County Health Department. Such refuse shall not be placed in containers for City collections.

(b) Hypodermic instruments. No person shall dispose of or discard any hypodermic syringe, hypodermic needle or any instrument or device for making hypodermic injections before first breaking, disassembling, destroying or otherwise rendering inoperable and incapable of reuse, such hypodermic syringe, needle, instrument or device, and without safeguarding the disposal thereof, by wrapping or securing same in a suitable manner so as to avoid the possibility of causing injury to the collection personnel.

(c) Ashes. Ashes that are to be hauled by the City must have been wetted and cool to the touch prior to collection. Ashes shall be placed in suitable containers of such size and weight that they can be handled by one man.

(d) Cardboard boxes and cartons. Prior to depositing refuse for collection in authorized containers or receptacles or in commercial containers, the person disposing of any such boxes or cartons or the person in charge of the premises shall collapse all cardboard boxes, cartons and crates.

Section 10-25. Collection and disposal.

All collectors of refuse who desire to haul over the streets of the City shall use a water-tight vehicle provided with a tight cover and so operated as to prevent offense odors escaping therefrom and refuse from being dropped, blown or spilled.

Section 10-26. Responsibility of owners and agents.

The owners or agents, tenants or lessees of all residential units and commercial establishments shall be responsible for compliance with this article.

Section 10-27. Maintenance of property.

(a) Sidewalks, alleys, and rights-of-way. All owners or occupants of property shall maintain their property in a clean and litter-free manner, including sidewalks, grass strips, one-half of alleys, curbs, or rights-of-way up to the edge of the pavement of any public street.

(b) Snow removal. Every person shall remove snow, ice or other obstructions from the sidewalk in front of their premises within six hours after such time as removal can first be reasonably effected.

(c) Sweeping into sidewalks or streets. No person shall sweep into or deposit in any street or sidewalk the accumulation of litter from any building or property.

Section 10-28. Violations.

Any person violating or failing, refusing or neglecting to comply with any provision or requirement of any section or subsection of this article, in addition to any other remedy, shall be punished by a fine not to exceed fifty dollars ($50.00) or imprisoned for not more than thirty (30) days for each and every offense."

"ARTICLE II-A.

ABANDONED MOTOR VEHICLES

Section 10-29. In general.

(a) Abandonment unlawful. It shall be unlawful to abandon any motor vehicle on any public street or public grounds or upon any privately owned property, and it shall be unlawful for any person controlling privately owned property to abandon or to permit the abandonment thereupon of any motor vehicle. Violation of this section shall be a misdemeanor punishable by fine or imprisonment, or both; provided, however, that no person controlling privately owned property shall be criminally liable for the abandonment of motor vehicles thereupon by others if he shall assist the duly designated officials and agents of the City in disposing of said vehicles in the manner prescribed in this article.

(b) Abandoned vehicles defined. For the purposes of this section, a vehicle shall be determined to have been abandoned in the following circumstances:

(1) It has been left upon a street or highway in violation of a law or ordinance prohibiting parking; or
(2) The vehicle fails to display a current license plate; or
(3) It is partially dismantled or wrecked; or
(4) It is incapable of self-propulsion or being moved in the manner for which it was originally intended; or
(5) It is left on property owned or operated by the City for a period of not less than 24 hours; or
(6) It is left on private property without the consent of the owner, occupant or lessee thereof for a period of not less than 24 hours; or
(7) It is left on any public street or highway of the City for a period of not less than seven (7) days.

(c) Removal.

(1) Any abandoned motor vehicle may be removed to a storage area for safekeeping by or under the direction of the Police Department or other person, firm or corporation so designated by the City. Written notice by mail of such removal shall be promptly given to the registered owner of the vehicle and to

any holders of any lien of record in the office of the Department of Motor Vehicles.

(2) No such vehicle shall be so removed from privately owned premises without the written request of the owner, lessee or occupant of the premises unless the same has been declared by the City Council to be a health or safety hazard.

(d) Disposition of vehicles.

(1) The owner of any removed vehicle, before obtaining possession thereof, shall pay to the agent of the City storing said vehicle all reasonable costs incidental to the removal, storage and locating of the owner.

(2) Should such owner fail or refuse to pay the costs, or should his identity or whereabouts be unknown and unascertainable after a diligent search and after notice as herein prescribed, the stored vehicle may be sold after twenty (20) days' notice has been given to the Department of Motor Vehicles before the date of sale, and after the vehicle has been held for not less than thirty (30) days.

(3) The vehicle may be sold by public or private sale, but no vehicle may be sold until its value has been determined by three disinterested dealers or garagemen.

(4) A vehicle of an appraised value of less than one hundred dollars ($100) may be disposed of by any means in the discretion of the storing agent of the City.

(5) The proceeds of any sale shall be forwarded to the treasurer of the City, who shall pay from the proceeds of said sale the cost of removal, storage, investigation as to ownership and sale, and liens in that order. If, after the sale, the ownership at the time of the removal is established satisfactorily to the treasurer, the owner shall be paid so much of the proceeds as remains after payment of the foregoing costs and liens. Otherwise, any remaining proceeds shall be deposited in the general fund of the City.

(e) Junk motor vehicles.

(1) Any abandoned vehicle which is inoperable, dismantled or damaged, five (5) years old or older, and worth less than one hundred dollars ($100) shall be deemed a junk vehicle. A junk vehicle shall be held at least fifteen (15) days, during which time the owner may reclaim it by exhibiting proof of ownership and paying all reasonable costs incident to removal and storage and administrative expenses.

(2) An unclaimed junk vehicle may be destroyed or otherwise disposed of after fifteen (15) days. Notice shall be given within fifteen (15) days after final disposition to the Department of Motor Vehicles that it was deemed a junk vehicle and disposed of as such. This notice shall fully and accurately describe said vehicle.

(3) **Any proceeds derived from the disposition of junk vehicles shall be deposited in the general fund of the City.**

(f) Disposition with owner's consent. With the owner's consent, the City may remove and dispose of any vehicle as a junk motor vehicle regardless of value or condition of said vehicle and without waiting the aforesaid fifteen (15) day period.

(g) Immunity. No person shall be held to answer in any civil or criminal action to any owner, lien holder or other person legally entitled to the possession of any abandoned, lost or stolen motor vehicle for disposing of it as contemplated herein.

(h) Exceptions. This section shall not apply to authorized automobile dealers or to authorized junk dealers in the operation of their businesses.

(i) Penalty. In addition to and separate and apart from any other remedies set forth and established by this section, any person violating the provisions of this section shall be assessed a penalty of ten dollars ($10.00), and each and every day during which such violation continues, shall be a separate and distinct offense."

"ARTICLE II-B.

COMMUNITY IMPROVEMENT

Section 10-30. Nuisances; designated.

It shall be unlawful for any person to create a nuisance on his lot or a lot occupied by him, or to allow a nuisance to remain on his lot or a lot occupied by him. Dead animals, stagnant water, decayed vegetables and fruits, filthy privies and stables, or to permit the existence of anything causing an offensive odor, or anything that causes injury or damage to the health or life of any other person, are declared nuisances.

Section 10-31. Trash and weeds; duty of person responsible.

(a) It shall be unlawful for any person to maintain premises, including vacant lots or land, upon which trash, garbage or miscellaneous refuse is permitted or caused to accumulate in any manner which is, or may become a nuisance, or cause injury to the health or welfare of residents in the vicinity or may injure neighboring property. Drive-in restaurants and other food establishments that permit carry-out food service shall maintain at all times on their premises sufficient receptacles for the disposal of trash, garbage and miscellaneous refuse.

(b) It shall be unlawful for any person to maintain, cause or permit uncut grass or weeds on any property under such circumstances that the grass or weeds are, or may become a nuisance.

(c) In the event the person or persons responsible, refuse to remove the trash, garbage, or refuse from the property on which it is allowed to accumulate, or refuses to cut grass or weeds within seven (7) days after notice in writing has been given by the City to the person responsible, he shall be deemed guilty of a violation of this section.

(d) If the person responsible for the conditions named above has not acted to correct the violation, the City Council shall hear and consider all objections and protests, if any, to the proposed removal by the City of the trash, garbage, or refuse, or to the proposed cutting of the grass and weeds. The Council shall then issue an order to the supervisor of the community improvement division of the City, and he, his assistants or deputies may enter upon the premises where the violation occurs and remove the trash, garbage or refuse, or cut grass and weeds.

(e) If the owner of the property, after [illegible]e notice, has failed or refused to remove the trash, garbage, or refuse, [illegible] to cut the grass or weeds, and the City has been authorised by council to do so and has so acted, in addition to all other remedies, the City may assess costs incurred by it, and this shall be a charge against the person responsible, and shall be a lien against the property from which the trash, garbage, or refuse has been removed, or the grass or weeds have been cut.

(f) In addition to and separate and apart from the other remedies set forth in this section and section 1-6, a violator of any of the above provisions may be assessed a penalty of ten dollars ($10.00), and each and every day during which a violation occurs shall be a separate and distinct offense.

Section 10-32. Community improvement division; duties and responsibilities of supervisor and inspectors.

The supervisor of the community improvement division and those inspectors assigned to assist him shall have the duty and responsibility of enforcing Articles II-A and II-B of this article. The supervisor and his inspectors shall enforce the provisions of these sections by the inspection of property and by the observance of those persons who are seen to violate any of the provisions. They shall be empowered to issue citations when in their opinion any of the provisions of these sections cited above have been violated. Citations so issued may be delivered in person to the violator by the supervisor or his inspectors, or they may be mailed to the person so charged, if he cannot be readily found. Any notice or citation so delivered or mailed shall direct the alleged violator to appear at the violations bureau of the city on or before a specific day and hour named in the notice; and the period so specified shall be not less than seventy-two (72) hours after its delivery to the violator.

When a person charged with violation of the sections administered by the community improvement division shall appear before the clerk on duty at the violations bureau in response to a citation as hereinabove provided, such clerk is authorized, if the person appearing so desires, to allow him to sign on the docket which is kept in connection with violations and pay the civil penalty assessed. Upon payment, the clerk shall give him a receipt for the money paid, showing the type of violation, and shall deliver the money to the collector of revenue for the city. A copy of the citation shall be mailed at the time of issuance to the captain of the records division of the police department.

The supervisor of the community improvement division shall cause all citation forms to be serially numbered in triplicate and records with respect to the said citation forms are to be maintained so that all of them can be accounted for. The city accountant, or his representative, shall periodically investigate the records of the community improvement division for the purpose of determining the disposition of the forms, and he shall report the result of such investigation to the city manager. For the purpose of making this investigation, the city accountant shall have access to the necessary records of the community improvement division.

If a violator of the provisions of these sections does not appear in response to the notice or citation at or before the date and hour named, a complaint will be filed and a warrant of arrest issued against that person.

Section 10-33. Severability.

If any provision of Articles II, II-A, and II-B of this Chapter is for any reason held to be invalid or unconstitutional by any Court of competent jurisdiction, such provision shall be deemed a separate, independent provision and such holding shall not affect the validity of any other provision, and to that end, the provisions of this Chapter are hereby declared to be severable."

Section 2. This ordinance shall become effective upon adoption.

Approved as to form:

(Signed) City Attorney

Appendix VII-2

Suggested Solid Waste Management

Ordinance

for

Local Government

March 1974

Table Of Contents

SUBJECT PAGE

1. Short Title 1
2. Declaration of Policy 1
3. Definitions 1
4. Administrative Department 3
5. Enforcement Agency 3
6. Powers and Duties of the Administrative Department 3
    6.01 Solid Waste Management Plan 3
    6.02 Solid Waste Management System 4
    6.03 Rules and Regulations 4
    6.04 Permits 4
    6.05 Bulky Waste Collection 6
    6.06 Dead Animals 6
    6.07 Contracts 6
    6.08 Solid Waste Management Districts 6
    6.09 Private Contractor Regulation 7
    6.10 Service Charges, Non-Residential Solid Waste 7
    6.11 Exclusive Service 7
7. Permits for the Management of Solid Waste 7
    7.01 Permit for the Storage, Transport, Processing and Disposal of Solid Waste by the Generator thereof. 7
    7.02 Storage Permit 8
    7.03 Permit for Solid Waste Collection 8
    7.04 Permit to Locate and Operate a Transfer Station 9
    7.05 Permit to Transport Solid Waste 10
    7.06 Permit to Locate and Operate an Incinerator 10
    7.07 Permit to Locate and Operate a Sanitary Landfill 10
    7.08 Permit to Locate and Operate a Resource Recovery Facility 11
    7.09 Permits to Issue 11
    7.10 Permits Denial 12
    7.11 Permit Number, Display 12
8. Powers and Duties of the Enforcement Agency 12
    8.01 Rules and Regulations 12
    8.02 Inspections 12
    8.03 Notices 12
    8.04 Citations 13
    8.04.1 Hearings 13
    8.04.2 Opinion 14
    8.05 Injunction 14
9. Solid Waste Management Advisory Board 14
    9.01 Appointment 14
    9.02 Terms 14
    9.03 Organization Meetings 14
    9.04 Duties 15
10. Time and Frequency of Collection 15
    10.01 Residential 15
    10.02 Non-Residential 15
11. Storage 15
    11.01 Residential 15
    11.02 Non-Residential 16
12. Containers 16
    12.01 Sanitation 16
    12.02 Defective Containers 16
    12.03 Residential Container Location Prior to Collection 16
13. Non-Containerized Waste 16

14. Bulky Waste 17
15. Dead Animals 17
16. Collections - Residential 17
17. Fees 17
    17.01 Establishment and Payment 17
    17.02 Delinquency 18
    17.03 Collection 18
    17.04 Uncollected 18
    17.05 Increase 18
    17.06 Hearings 18
18. Insurance 19
    18.01 Performance Bonds 19
    18.02 Payment Bonds 19
    18.03 Liability Insurance 19
19. Permit Renewal 19
20. Permit Fees 19
21. Appeals 20
22. Appeals, Alternative 20
23. Computation of Time 20
24. Title to Waste 21
25. Prohibited Activities 21
    25.01 Dead Animals 21
    25.02 Littering 21
    25.03 Acts Contrary to Ordinance 21
    25.04 Vehicle Construction 21
    25.05 No Interference with Authorized Solid Waste Management 21
    25.06 Scavenging Prohibited 22
    25.07 False Information 22
    25.08 Dumps Prohibited 22
    25.09 Burning Prohibited 22
    25.10 Animal Feeding 22
    25.11 Illegal Use of Permit Number 22
    25.12 Hazardous Waste 22
26. Penalties 22
27. Repealer 23
28. Savings Clause 23
29. Severability Clause 23
30. Effective Date 23

Suggested Solid Waste Management Ordinance for Local Government

An Ordinance authorizing and directing the planning, establishment, maintenance and operation of a comprehensive solid waste management system; the establishment and enforcement of necessary and proper regulations for the management of solid waste; the establishment and collection of residential solid waste management service charges, and for other purposes.

COMMENT: *The preamble is a means of indicating legislative intent, or the problems which led to the enactment of the law. It is not a part of the law itself.*

1. Short Title

This ordinance shall be known any may be cited as the Solid Waste Management Ordinance of (____________).

COMMENT: *This ordinance would be applicable to any political subdivision of the State and could be used, with modification, in a multi-jurisdictional agency where appropriate legislative authority has been given.*

2. Declaration of Policy

It is hereby declared to be the purpose of this ordinance to regulate the storage, collection, transport, processing, recovery, and disposal of solid waste in order to protect the public safety, health, and welfare and to enhance the environment of the people of (____________).

COMMENT: *This is the official expression of the intent of the legislative body enacting the ordinance. A court interpreting the ordinance, in whole or in part, would be obligated to arrive at the intent of the legislature, in this case, the protection of public safety, health, and welfare, and environment.*

3. Definitions

For the purposes of this ordinance, the following words and phrases shall have the meaning given herein unless their use in the text of the ordinance clearly demonstrates a different meaning.

Abandoned Vehicle – A vehicle that applicable State laws deem to have been abandoned.

Administrative Department – The Department of this municipality charged with the administrative management of this ordinance.

Agricultural Solid Waste – The solid waste that results from the rearing and slaughtering of animals and the processing of animal products and orchard and field crops.

Bulky Waste – Items whose large size precludes or complicates their handling by normal collection, processing, or disposal methods.

Collection – The act of removing solid waste from the central storage point at the source of generation.

Commercial Solid Waste – Solid waste generated by stores, offices, and other activities that do not actually turn out a product.

Commissioner – The duly qualified and appointed person in charge of the Agency which is responsible for the enforcement of those aspects of this ordinance related to the protection of the public safety, health, welfare, and environment.

Dead Animals – Animals that have died from any cause except those slaughtered for human consumption.

Director – The duly qualified and appointed person in charge of the department which is responsible for the administrative management of this ordinance.

Disposal – The orderly process of discarding useless or unwanted material.

Dump – A land site where solid waste is disposed of in a manner that does not protect the environment.

Enforcement Agency – The Agency of this municipality charged with the enforcement of those aspects of the ordinance related to the protection of the public safety, health, welfare and environment.

Generation – The act or process of producing solid waste.

Hazardous Waste – Those wastes such as toxic, radioactive or pathogenic substances which require special handling to avoid illness or injury to persons or damage to property.

Incineration – The controlled process by which solid, liquid, or gaseous combustible wastes are burned and changed into gases, and the residue produced contains little or no combustible material.

Industrial Solid Waste – Solid waste that results from industrial processes and manufacturing.

Institutional Solid Waste – Solid waste originating from educational, health care, and research facilities.

Local Government – A public corporation, created by Government for political purposes, and having subordinate and local powers of legislation: e.g., a county, town, city, etc., or combination thereof.

Natural Resources – Materials which have useful physical or chemical properties which exist, unused, in nature.

Non-Residential Solid Waste – Solid waste from agricultural, commercial, industrial, or institutional activities or a building or group of buildings consisting of five or more dwelling units.

Incinerator – An engineered apparatus used to burn waste substances and in which all the factors of combustion – temperature, retention time, turbulence, and combustion air – can be controlled.

Person – Any individual, partnership, copartnership, firm, company, public or private corporation, association, joint stock company, trust, estate or any other legal representative, agent or assigns.

Pollution – The condition caused by the presence in the environment of substances of such character and in such quantities that the quality of the environment is impaired or rendered offensive to life.

Processing – Any method, system, or other treatment designed to change the physical form or chemical content of solid waste.

Recovered Resources – Materials which still have useful physical or chemical properties after serving a specific purpose and can, therefore, be reused or recycled for the same or other purposes.

Recovery – The process of obtaining material or energy resources from solid waste. Synonyms: extraction, reclamation, salvage.

Energy Recovery – The obtaining of energy available from the heat generated when solid waste is incinerated.

Recycling – The process by which recovered resources are transformed into new products in such a manner that the original products lose their identity.

Rendering – A process of recovering fatty substances from animal parts by heat treatment, extraction, and distillation.

Residential Solid Waste – All solid waste that normally originates in a residential environment. This definition is applicable to the solid waste from a building of four or less separate units.

Reprocessing – The action of changing the condition of a secondary material.

Reuse – the reintroduction of a commodity into an economic stream without any change in its physical characteristics.

Salvage – The utilization of waste materials.

Salvaging – The controlled removal of waste materials for utilization.

Sanitary Landfill – A site where solid waste is disposed using sanitary landfilling techniques.

Sanitary Landfilling – An engineered method of disposing of solid waste on land in a manner that protects the environment by spreading the waste in thin layers, compacting it to the smallest practical volume, and covering it with soil by the end of each working day.

Scavenging – The uncontrolled removal of materials at any point in solid waste management.

Scrap – Discarded or rejected material or parts of material that result from manufacturing operations and are suitable for reprocessing or recycling.

Home Scrap – Scrap that never leaves the manufacturing operation and is routinely reprocessed. (Also referred to as mill scrap, mill broke, or turn around scrap).

(Prompt) Industrial Scrap – Scrap that is generated during the manufacture of a product.

Secondary Material – A material that is utilized in place of a primary or raw material in manufacturing a product.

Separation – The systematic division of solid waste into designated components.

Solid Waste – Useless, unwanted, or discarded material with insufficient liquid content to be free flowing.

Solid Waste Management – The purposeful, systematic control of the generation, storage, collection, transport, separation, processing, recovery and disposal of solid waste.

Storage – The interim containment of solid waste, in an approved manner, after generation and prior to ultimate disposal.

Transport – The movement of solid waste subsequent to collection.

Transfer Station – A site at which solid waste is concentrated after collection and before processing or disposal.

COMMENT: *Definitions are important to clarify the meaning of terms which are not self explanatory. A definition section is an integral part of a solid waste management ordinance. This section is important to the administration and interpretation of the ordinance. Unduly restrictive or vague definitions should be avoided. Another purpose of a section of definitions is to assist anyone interpreting the ordinance or section, in arriving at legislative intent. In the absence of definitions, the ordinary meaning of the language under scrutiny would be used. State legislation will control collection, storage and disposal of abandoned vehicles including their definition, and must be the source of local authority for action. Some States have recently enacted enabling legislation for municipal action in this field.*

Reproduced from best available copy.

4. Administrative Department

The Department of (________________) shall be responsible for the administrative management of this ordinance and the rules and regulations authorized in Section 6.01.

COMMENT: *Solid Waste Management is normally the responsibility of the Department of Public Works, or a similar agency, which may be headed by an executive called the Director. Depending upon the local government organization or the services to be rendered, the responsibility for solid waste management may be assigned to an organizational unit within the Department of Public Works, or may be a separate function of local government.*

There are advantages and disadvantages to having a separate organizational unit. The advantages include a separate budget, more visibility to the public and elected officials, total attention devoted to the problem, no sharing of equipment and personnel, direct responsibility to the elected officials, and a higher priority status. The disadvantages include further fragmentation of local government, lack of coordination with related programs and duplication of certain types of personnel (e.g., budget, research, accounting).

5. Enforcement Agency

The (________________) Agency shall be responsible for the enforcement of those aspects related to the protection of the public safety, health, welfare, and environment of this ordinance and the rules and regulations authorized in Section 8.01.

COMMENT: *This is a responsibility that may be assigned to the agency in charge of health related activity, usually the Department or Board of Health, under the direction of a Commissioner. The trend at the State level and in large population areas is to create a separate agency charged with the responsibility of environmental protection. The development and enforcement of rules and regulations pertaining to safety, health, welfare and the environment would be a function of that agency.*

Administrative management and enforcement responsibility may be combined in one agency where permitted by law.

6. Powers and Duties of the Administrative Department

6.01 Solid Waste Management Plan. The Director, in co-operation with the Commissioner of the Enforcement Agency, and with the advice of the Solid Waste Advisory Board, shall survey the solid waste management practices within the locality and prepare a Solid Waste Management Plan to be compatible with the State plan, showing therein all present management activities and recommended management activities for future use, taking into consideration population growth, solid waste generation, land development regulations and overall system management including organizational, financing, and regulatory capabilities. The plan shall consider the qualitative and quantitative increase in the solid waste expected to be generated within the area governed from residential, commercial, industrial, and agricultural sources, and shall be submitted to the State for review and approval. The plan developed should not only consider area wide approaches, but must be designed to be operational and when implemented must be an environmentally acceptable and economically efficient solid waste management system.

COMMENT: *The primary sources of authority for local government activity are the State Constitution and enabling legislation, which sets out the areas where local activity can take place. A further restraint is in State laws setting standards which must be met by all inferior units of government. Before any legislative action is* *taken, these areas must be studied carefully to assure that it is authorized. Otherwise the legislation enacted will be null and void, which will cause problems, including legal action against the local government.*

The use of the word "shall" in legislation usually imposes a mandatory duty upon the official involved. Here, the Director of the Administrative Department has the duty to prepare a plan for solid waste management. In cases where a discretionary duty is given by legislation "may" is used. No time limit is set here for implementation because each governing body will have unique problems which must be solved and it will be the best judge of any time restraints, subject to those set forth by the State on the preparation and implementation of the Solid Waste Management Plan, which must not conflict with that of any higher authority.

Although the Director is responsible for the Solid Waste Management Plan, its development and implementation must be coordinated with all governmental units with a responsibility or interest in solid waste management. The plan for solid waste management must serve five functions: (1) provide a technical and policy guideline for effective solid waste management; (2) provide a public directed framework of standards for solid waste management planning and implementation; (3) provide for an integrated management system covering all elements from generation through disposal either through direct operations or regulated performance; (4) establish methods and procedures for translating the plan into system design and direct operations; (5) serve as a legislative support document for furthering the improved management of solid waste within the jurisdiction.

6.02 *Solid Waste Management System.* The Director shall provide for a solid waste management system consistent with the Solid Waste Management Plan, consisting of storage, collection, transport, processing, separation, recovery, and disposal through public ownership, or through exclusive agreements with one or more persons for a part or all of such solid waste system, or he may, through the permits in Sections 6.04 and 7.01 authorize any person to manage the solid waste which he generates pursuant to the terms of this ordinance.

COMMENT: *In arriving at the decision to use public or private resources, or any combination of the two, local government must consider such factors as capital investment, personnel resources, service to be rendered, operating and maintenance costs, and the revenue required to support the solid waste management system.*

In any event, control must always be retained by local government which can be accomplished by the use of permits, the establishment of fees, rules and regulations and the use of inspection powers.

For example, the local government could process or dispose of solid waste while the collection could be provided by private enterprise.

This suggested ordinance is designed to permit the local government to select either a public or private solid waste management system or combination thereof and still operate within its provisions.

6.03 *Rules and Regulations.* The Director may adopt, revise, revoke and enforce rules and regulations governing the administration of this ordinance.

COMMENT: *The authority given here is limited to those rules and regulations applicable to administration and does not include the rules and regulations governing safety, health, welfare and environment which are the responsibility of the Enforcement Agency. These rules and regulations must be compatible with state law and applicable rules and regulations of the state.*

6.04 *Permits.* The Director is hereby authorized to issue permits for all elements of solid waste management including alteration of existing facilities or systems. All such permits shall be non-transferable, shall be for a term of one year and shall be subject to the fees set forth in Section 20. All permits so issued shall be conditioned upon observance of the laws of this State, the ordinances of this governing body and the rules and regulations authorized herein.

COMMENT: *Permits are needed even in a publicly operated solid waste management system. By their use, regulation is achieved from identification of waste at the point of generation through disposal. This ordinance provides that all persons, other than those storing their own residential solid waste must possess a valid permit for each step through disposal, with issuing authority being vested in the Director of the Administrative Department.*

Permits have a long history of use in the regulation of business or professions. When used in a solid waste management system they identify all persons involved in solid waste management, the type of waste being managed and to control its movement through disposal by approved methods.

The permits authorized in an ordinance are supplemental to permits required by either State or local law. A permit to operate an incinerator would not excuse the holder from receiving clearance from the State Air Quality Act, as well as the Water Quality Act where quench waters are involved. Local building permits and building codes would be prerequisites to the issuance of the permits authorized here.

The permits are expressly conditioned upon observance of all applicable laws and the rules and regulations authorized herein. Therefore, failure to observe either would be a valid ground for suspension or revocation. Such action may be a drastic step, and should be used only when alternative solid waste management systems or methods are available. For example, if there is only one sanitary landfill, revocation of that permit might create more problems than it solves.

The Director of the Administrative Department is authorized to prepare application forms which must include all information required by Section 7, with an omnibus clause to use for any special information required by the local government.

Since fraud vitiates a legal document, a false statement (see Section 23.07) in the application would be grounds for revocation. In such case, good judgement would dictate weighing the falsity and, if of a minor nature, taking no action.

Since the permit is not transferable, the purchaser of an activity controlled by a permit would be required to apply for and receive the authorization prior to continuing the regulated activity.

There are fields of activity in solid waste management where the number of permits should be limited in order to insure efficient and economical operation. In those areas, the Director would have the right to refuse to entertain new applications. An illustration of this is in collection, where the area served will generate sufficient revenues to attract a limited number of qualified applicants. In other words, if a large number of permit holders are in a limited area, there will be a duplication of routes resulting in short cuts in service, which are not compatible with proper solid waste management.

The governing body should establish the time period the permit should be in force. Many localities are on a one-year time frame corresponding to the budget period while others have various periods up to five years. In a smaller locality where little paperwork is involved in renewing permits, one year might be a good time period. For a large locality with many permits in force the work load may be too great for annual renewal; therefore a longer interval might be preferred. A permit term of one year is set forth here and would give an added control tool to the Director, who could refuse to renew the permit where a long history of minor substandard performance is involved.

Application and permit fees are the rule rather than the exception. An application fee would have to accompany each application and would aid in meeting administrative costs, therefore it should not be returned. It will also determine the sincerity of the applicant. Application for the renewal of an existing permit need not require a fee.

Initial or renewal permit fees should be realistic. A fee which exceeds the cost of issuance and supervision should be avoided, as well as one of a nominal amount. The desirable figure would be one which would make the permit system self-supporting.

The Director should evaluate the information given in each application. In doing this they can inspect physical facilities to assure compliance with the applicable standards and, at the same time, weigh intangibles, such as personnel qualifications, operational plan, financial responsibility, etc.

Once the inspection is completed the Director has open three courses of action. He can issue the permit; he can deny the permit, in writing, stating the reasons therein or, he can inform the applicant of the changes needed to allow the permit to issue.

Any substantial alterations, modification or enlargement must be by permit, a matter which can be covered by the omnibus clause in each section setting forth application form contents. The same clause can be used for other needs peculiar to the user municipality, such as performance bonds.

In any denial of application, the action of the Director must not be arbitrary.

The rules and regulations for the administration of the ordinance should set out administrative procedures for the processing of applications, including the time period between receipt of the application and the action authorized in Section 7. The Director should have an interval which will allow a careful review, keeping in mind that there will be other applications and duties which must receive attention. To allow inaction to replace a positive approval or disapproval within a time frame should be avoided. When an application is rejected, the applicant has the right to utilize the appeals procedures set forth in Section 21.

6.05 Bulky Waste Collection. The Director shall establish the necessary procedures to collect and dispose of bulky waste from residential units within this locality.

COMMENT: *Bulky Waste is defined in Section 3 and would include any solid waste which could not be picked up during routine collection. If a packer truck is used, the size of the opening would be the limit on bulky waste. The usual bulky waste would include "white goods," that is stoves, refrigerators or washers, or such items as furniture or hot water tanks. Interior storage prior to pick-up is needed to avoid unsightly accumulations at residences. The size of the locality will determine schedule. A small locality could make one collection per month, with larger localities needing a more sophisticated approach. The owner of such waste items in a small locality would not be prohibited from taking bulky items to an approved processing or disposal facility. Under the powers in Section 6.02 this could be either a public operation or it could be done by contract.*

6.06 Dead Animals. The Director shall provide the necessary equipment and personnel to remove dead animals within this locality and shall schedule such collections to provide pick-up with a minimum delay. This Section shall not apply to dead animals, or parts thereof, from any commercial or agricultural activity within this locality.

COMMENT: *This Section is designed to provide the sanitary collection and disposal of dead animals within the locality and to prevent the use of normal solid waste collection service for dead animal disposition. Such service would include animals killed in traffic. Disposal would be through existing facilities, such as an incinerator or a sanitary landfill.*

6.07 Contracts. All contracts entered into by the Director under this ordinance shall meet the following minimum requirements:

a. Be with the consent of the Legislative Body of this locality.
b. Prior approval of the chief legal officer of this locality.
c. Be for a term of not less than ________ years, nor more than ________ years.
d. Meet the insurance requirements of this ordinance.
e. Be awarded to the lowest and best bidder.
f. Show full details of ownership of the successful bidder, including the names and addresses of all principals, or officers and majority stockholders, if a corporation.
g. Such other conditions as may be set forth in instructions to bidders or other necessary qualifications, as required by the contemplated work.

COMMENT: *All contracts entered into by the Director of the Administrative Department shall be with the consent of the local governing body. It should be approved by the chief legal officer, who will have been active in its drafting. A contract for a one-year period will be too short to attract bidders where large financial commitments for facilities and equipment are involved. Present economic conditions do not encourage a long term contract unless it contains provisions for adjustment to meet increased costs brought about by inflation. In drafting such clauses it should be kept in mind that changes in techniques may result in lower costs; therefore, a change in the contract prices should include this factor, which can also be invoked in a deflationary period.*

Insurance bonds are required by Section 18 and are limited to performance and payment bonds and liability insurance. The payment bond would include premium liability and equipment liability. In those States where private insurance companies handle workmen's compensation, that requirement would be included in the ordinance.

Price alone is not a good determinant for the award of a contract since high standards may be expensive. Another factor to be considered is that the lowest bidder may be forced to reduce services in order to make a profit.

6.08 Solid Waste Management Districts. The Director is hereby authorized to create one or more solid waste management districts within the boundaries of this locality in order to provide efficient and economical solid waste management.

COMMENT: *This section and the following sections will enable the Director to obtain efficient and economical solid waste management by the creation of districts and the regulation of private contractors to serve each district so created.*

Regulation, through permits, of the optimum number of private persons will eliminate inefficiency, such as duplication of routes.

6.09 Private Contractor Regulation. The Director shall determine the number of contractors needed to efficiently serve the locality or all districts created under Section 6.08 and shall issue permits to the contractor or contractors who are found to be qualified until the needs of the locality are met. Nothing in this ordinance shall prevent one contractor from serving the locality or all districts created under Section 6.08.

COMMENT: *This will give the Director the needed authority to exercise control over private contractors who are managing solid waste within the locality. The goal to be achieved is efficient and economical service to all generators of solid waste and it may be achieved through the use of one or more contractors. This section would also allow the use of one or more contractors for collection and one or more contractors for disposal, or both collection and disposal could be combined under one contract. If the system used involves other activity, such as processing or resource recovery, that could be included in each district authorized by this section.*

6.10 Service Charges, Non-Residential Solid Waste. The Director shall not set or regulate any service charges for non-residential waste management by private contractors.

COMMENT: *This section is directed to contractors serving non-residential solid waste sources, who are left free to negotiate for the fees charged their customers. This section would not be used in any area where a local government monopolizes solid waste management. This suggested ordinance is designed for use in a locality where non-residential solid waste may be managed by private industry under the control of the local government; therefore, all non-residential waste is classified as commercial. A building or group of buildings consisting of five or more dwelling units is classified as a commercial enterprise and will not be served as a part of the residential solid waste management system. If solid waste management is regulated as a utility, this section would not apply.*

6.11 Exclusive Service. All generators of solid waste, other than those operating under permits as authorized in Section 7.01, shall use the services of the local government or contractor for the district in which the solid waste is generated.

COMMENT: *The restriction on the number of contractors servicing a district, coupled with the requirement that all generators, residential or otherwise, use the services of the local government or contractor will allow economical and efficient service.*

Section 7.01 would exempt non-residential waste generators from this requirement as they would provide for their own total solid waste management. In such cases, the applicant would have to meet all the provisions regulating the activity of permit holders and would have to pay such fees as are set for that activity. Renewals, as in all other permits, would be required also.

7. Permits for the Management of Solid Waste

7.01 Permit for the Storage, Transport, Processing, and Disposal of Solid Waste by the Generator thereof. The Director shall prepare application forms for all such permits, requiring the following information:

a. The name and address of the applicant, showing its legal identity (corporation, partnership, association, etc.);
b. The business address of the applicant;
c. The types of waste to be covered by the permit;
d. The methods of storage, transport, processing and disposal;
e. Proof of all insurance required by this ordinance (State financial responsibility limits for motor vehicles, etc);
f. The route or routes to be used in transporting and schedules used;
g. The location and type of processing and/or disposal contemplated;
h. Information as required to indicate compliance with the Occupational Safety and Health, and Environmental Protection Laws of the federal and/or state governments.

COMMENT: *Consideration of safety and the environment are of prime importance. A permittee should be required to indicate what kind of safety measures would be taken in his operations, and how he intends to* *comply with the law. Consideration should be given to the preparation of an Environmental Impact Statement by the agency; the permittee would be required to respond with measures toward mitigating any impacts.*

7.02 Storage Permit. The Director is hereby authorized to prepare application forms for permits for the storage, on premises, of all solid waste generated and retained thereon for more than twenty-four continuous hours. Provided, however, this section shall not apply to a resident of a building of four or less separate dwelling units. Such application shall require:

a. The name and address of the applicant, showing its legal identity (individual, partnership, corporation, etc.); and the business address of the applicant;
b. The classification, anticipated volume and weight of all solid waste to be stored;
c. The location, description and owner of all storage containers and ancillary equipment;
d. Frequency of collection, processing or disposal, showing all permit numbers thereof;
e. All other information reasonably required by the Director to fulfill the intent of this ordinance.

COMMENT: *Effective solid waste management begins at the point of generation. Since the act of producing solid waste cannot be totally controlled, the first element of management to be placed under a permit is storage.*

The 24-hour time limit is arbitrary and may be varied to suit the solid waste management plan of the local government. Such a time limit serves to stimulate the movement of solid waste between the point of storage and further management.

The applicability of this section of 5 or more residences generally is the division between residential and commercial activities. Efficient storage at such facilities would result in the use of bulk containers which must be controlled.

The exemption of normal household waste from a building of four or less dwelling units can be used to prevent the accumulation of waste such as inoperative vehicles and bulky waste on such premises.

As part of the solid waste management plan, the Director will classify the waste by its component parts. The application of classification will depend upon the activity conducted within the locality. Estimated volume and weight are necessary for comprehensive management of all solid waste from the locality.

The requirement of the location of storage containers will allow pre-permit inspection. If exterior locations are involved, sanitation and aesthetics must be evaluated. If interior locations are involved, fire hazards must also be considered. In describing the containers the applicant need only specify the number and type, such as bulk containers or plastic bags. Auxiliary equipment, such as compactors, shredders and balers should be listed by manufacturer, model number and the operational plan for each.

The requirements of subsection (d) will enable the Director to evaluate adequacy of present collection practices and to cross-check other activity requiring a permit.

The omnibus provisions of (e) can be utilized to obtain compliance with the health, safety and environmental requirements of the local governing body.

7.03 Permit for Solid Waste Collection. The Director shall prepare application forms for all such permits, requiring the following information:

a. Name and address of the applicant, showing its legal identity (individual, partnership, corporation, etc.);
b. The business address of the applicant;
c. The identity of the non-residential customers using the collection service and all storage permit numbers of same; If residential collection, the area served, hours of collection and type of collection service to be provided;
d. The routes used for the movement of solid waste between collection and further management;
e. An inventory of all motorized equipment to be used in such collection, including all permits required by law;
f. Proof of all insurance required by this ordinance. (State Financial responsibility limits for motor vehicles, etc.);
g. All other information reasonably required by the Director to fulfill the intent of this ordinance.

COMMENT: *This is another step in the permit process of identifying and regulating solid waste management. It would apply where private industry is engaged in collection of solid waste, ranging from a contract operation for an entire city or county downward to a collector who may serve a particular type of industry.*

The type of waste being collected is important since it will enable intelligent regulation by the enforcing arm of the local government. Waste, such as brick, stone and mortar, would need little control, whereas waste from a health care facility or food service establishment would require close regulation to minimize health problems. The identity of the user of the collection system would allow a crosscheck for observance of other requirements of the law.

Supplying the Director with the names of customers will allow an evaluation of the scope of the contract and will allow a crosscheck of storage permits. It would be impractical to list all residential users of a collection service but the area served should be described so that maximum efficiency and economy can be obtained through the authority to limit the number of contractors in a given area. Existing contracts would not be affected but could be controlled by permit issuances as contracts expire.

Any contractor will have a plan of operation, including routes, which will enable the Director to see that collection will not interfere with core area traffic and to prevent heavy traffic on residential streets. The type of service would range from curbside bags to taking the filled container to the collection vehicle and returning the empty container to its proper location.

Once a collection vehicle has been filled, the Director should know the route or routes to be used in further management, such as delivery to a transfer station, an incinerator, a recovery station or a disposal site, thereby providing another tool in planning solid waste management, such as alternative routes to provide efficient traffic flow and the location needs for transfer stations.

The equipment inventory will enable the Director to evaluate the ability of the applicant to fulfill his commitments as outlined to this point. Authority under this ordinance does not excuse compliance with state or other licensing laws or permits, such as a public utilities commission.

Insurance requirements are twofold in nature; protection of property and person and protection of the local government. The former is achieved through liability policies, including those on motor vehicles and the latter through performance bonds.

The last subsection could be used to require the applicant to file copies of existing contracts so that overlapping contracts can be eliminated.

7.04 Permit to Locate and Operate a Transfer Station. The Director is hereby authorized to prepare application forms for permits to locate and operate transfer stations in this locality when applicable, requiring the following information.

a. The name and business address of the applicant;
b. A full legal description of each site, including the name and address of each owner of record. If not owned by the applicant, documentary proof of the right to use each site, with appropriate site plans;
c. Clear evidence of approval by all other regulatory agencies;
d. Operational plan including classification, anticipated volume and weights of solid waste, hours of operation, and resource recovery activity or potential;
e. Applicable permit numbers of persons using each facility;
f. Inventory of all fixed equipment;
g. The method or methods of transporting the solid waste from the transfer station for further management, the destination, route, and identity of the carriers involved;
h. Certificates of all insurance required by this ordinance;
i. All other information reasonably required by the Director to fulfill the intent of this ordinance.

COMMENT: *Generally, two factors determine the use of transfer stations. Volume and distance to the next step of management make it inefficient and uneconomical to use collection vehicles. There may be circumstances peculiar to a locality where a factor or factors other than distance make a transfer station desirable. The need for transfer stations is a matter which will be resolved in the planning stage authorized in Section 4.01.*

The legal description will locate the site. Ownership need not be in the applicant, who may have leased the premise or who may have an option to buy or lease the property. The details of the site plans would depend upon the requirements of other regulatory bodies, which would include approval by a zoning board. As mentioned earlier, the user of this ordinance should look to State statutes for his authority to act. Permit numbers of users can be used by the authorities as a cross-check for full compliance with the ordinance. Fixed equipment, such as a compactor or scales, would be used to evaluate the performance of the unit. Movement from the transfer station may be by truck, barge or railroad and must have the capacity to assure prompt movement from the transfer station.

If the user wishes to include alteration or modifications of a transfer station such requirements could be under the omnibus section.

Sanitation, including periodic removal of all solid waste for cleaning the facility, would be set out in the rules and regulations of the enforcement agency.

7.03 Permit to Transport Solid Waste. The Director is hereby authorized to prepare application forms to transport solid waste, originating in this locality, by any method not covered by any other provision of this ordinance, requiring the following information:

a. The name and business address of the applicant (individual, partnership, corporation).
b. The methods of transport, unit volume, schedule of movement routes used and the identity of the persons in the control of movement step.
c. All other information reasonably required by the Director to fulfill the intent of this ordinance.

COMMENT: *The primary thrust of this section is directed to the movement of solid waste other than by the collection vehicle. This would include movement from the transfer station, residue for incinerators or nonrecoverable residue from resource recovery activities. When a contract operation is involved a local government may regulate transportation beyond its borders. In a railhaul situation the contract could require the right of way to be kept free of solid waste spillage.*

7.05 Permit to Locate and Operate an Incinerator. The Director is hereby authorized to prepare application forms for permits to locate and operate incinerators or to operate existing incinerators in this locality, requiring the following information:

a. The name and address of the applicant, showing its legal identity (individual, partnership, corporation, etc.);
b. The business address of the applicant;
c. A full legal description of each site, including the name and address of each owner of record. If not owned by the applicant, documentary proof of the right to use the site, with the appropriate site plans;
d. Clear evidence of approval by all other regulatory agencies;
e. Operational plan, including classification, anticipated volume and weight of solid waste to be incinerated, hours of operation, anticipated volume and weight of residue, and resource recovery activity;
f. The method of transporting the residue from the incinerator, the destination and identity of the carriers involved;
g. Certificates of all insurance required by this ordinance;
h. All other information reasonably required by the Director to fulfill the intent of this ordinance.

COMMENT: *Under the definitions in Section 3, this section regulates all solid waste incineration within the locality, including backyard burners and on site activity by businesses, therefore each user must have the prior approval of air pollution control authority before the permit will be issued. The two positive steps authorized are in resource recovery activity and residue disposal.*

The user of this suggested ordinance may wish to include design and performance standards for the incineration process and the handling of waste, including the residue, in all facilities constructed after its effective date. This could also be required in increasing the quality of performance of existing facilities.

7.07 Permit to Locate and Operate a Sanitary Landfill. The Director is hereby authorized to prepare application forms for permits to locate and operate a sanitary landfill in this locality, requiring the following information:

a. The name and address of the applicant, showing its legal identity (individual, partnership, corporation, etc.);
b. The business address of the applicant.
c. A full legal description of each site, including the name and address of each owner of record. If not owned by the applicant, documentary proof of the right to the site, with the site plans which conform to the requirements of this ordinance.
d. Clear evidence of approval by all other regulatory agencies.
e. The engineering design report, prepared by an engineer licensed to practice that profession in this State, including but not limited to the following:
  1. Hydrology and climatology
  2. Soils and geology
  3. Site improvements
  4. Volume requirements
  5. Control of leaching and gas movement

  6. Surface and groundwater protection
  7. Completed use
  8. Location of residences and structures
  9. Access streets, roads and highways
f. Operational plan which shall include, but not be limited to:
  1. Hours of operation
  2. Classification of waste
  3. Anticipated volume and weight of waste
  4. Hazardous waste handling
  5. Equipment to be utilized
  6. Landfilling methods
  7. Availability of cover material
  8. Anticipated life of the site
g. All other information reasonably required by the Director to fulfill the intent of this ordinance.

COMMENT: *In designing the permit form, the user will have to act within the constraints of applicable State law and the rules and regulations authorized therein. Thorough planning and the application of sound engineering principles to all stages of site selection, design, operation and completed use will result in a successful and efficient sanitary landfill. In order to meet this objective, it is essential that the rules and regulations be comprehensive so that the director can evaluate the applicant's design and operation plans.*

7.08 Permit to Locate and Operate a Resource Recovery Facility. The Director is hereby authorized to prepare application forms for permits to locate and operate facilities to recover material or energy resources from solid waste within the locality, requiring the following information:

a. The name and business of the applicant;
b. Clear evidence of approval by all other regulatory agencies;
c. A full legal description of each site, including the owner of record or, if non-owned, documentary proof of the right to each site, with appropriate site plans;
d. An operational plan, including the classification, volume and weight of solid waste to be delivered, the materials to be recovered, anticipated volume and weight of nonrecoverable residue and hours of operation;
e. The method of transporting the residue from the recovery facility, the destination and identity of the carriers involved;
f. Certificates of all insurance required by this ordinance;
g. All other information reasonably required by the Director to fulfill the intent of this ordinance.

COMMENT: *The need to preserve natural resources has been apparent for some time and has resulted in the passage of the Resource Recovery Act of 1970 (P.L. 91-512). This section is another step in identifying solid waste management and is intended to regulate an activity primarily engaged in resource recovery from solid waste. It would not apply to a paperstock dealer, can manufacturer, or similar activities buying recovered resources to be recycled or reused. Nor would it apply to a retail outlet operated by a charity, since the stock there is donated.*

Two points must be kept in mind by the user of this suggested ordinance. The permits which are authorized in Section 7.01 to 7.08 will not excuse requirements of other regulatory bodies within the locality or higher level within the State. All permit provisions here would apply to both public and private activity, therefore those users who want a public activity excluded must do so.

7.09 Permits to Issue. If the application for any permit required herein shows that the applicant will perform the services or operate the facility, or both, for which the permit is sought, in conformity with the laws of this State, locality and the provisions of this ordinance, including all rules and regulations authorized herein, the permit or permits shall issue. If, in the opinion of the Director of the Administrative Department, modifications can be made which will bring the application within the intent and purpose of this ordinance, he shall notify the applicant or applicants, in writing, setting forth the corrections to be made and the time in which such corrections shall be completed.

COMMENT: *In all instances where all legal requirements are met, the Director is obligated to issue the permits for which application is made. If there are corrections which would bring about full compliance then this should* *be brought to the attention of the applicant and a specific time limit set for compliance. The desirable course to follow here would be one which would encourage applicants to upgrade their application to meet the standards set out in the ordinance. The time limit should be realistic. No provision has been made for an extension of the original time period because this could lead to procrastination. No permit should be issued until full compliance has been assured.*

7.10 Permits, Denial. If the applicant fails to make the corrections pursuant to the notice given under Section 7.10 within the time limit specified therein, or, if the application does not clearly show that the applicant will render services or operate the facility without health hazard or adverse effects on the environment, the application shall be denied and the applicant notified, in writing, stating therein the reasons for the denial. Nothing in this section shall prevent any applicant from reapplying after the rejection of his application, provided the requirements of this ordinance are met.

COMMENT: *The intent of the ordinance includes the identity of all solid waste sources and assurance that total management will enhance the environment and protect the health, safety and welfare of the inhabitants, therefore an application which does not assure full compliance with those requirements must be denied, even though it may eliminate a business. Few businesses will refuse to meet any reasonable requirement and will be in a position to find other successful applicants for temporary waste management.*

7.11 Permit Number, Display. All motor vehicles operating under any permit required by this ordinance shall display the permit number or numbers on each side, in colors which contrast with that of the vehicle, such numbers to be clearly legible and not less than 12 inches high.

COMMENT: *This section will enable the enforcement agency to check on all motor vehicles used in solid waste management as a means of enforcing permit requirements and to prevent the unauthorized use of permit numbers.*

8. Powers and Duties of the Enforcement Agency

8.01. Rules and Regulations. The enforcement agency shall adopt, revise, revoke and enforce rules and regulations governing the health, safety, welfare and environmental aspects of solid waste management within this locality. These rules and regulations must be compatible with state law and applicable state rules and regulations.

COMMENT: *The success of effective solid waste management will depend upon the rules and regulations authorized here. The intent is to allow flexibility in drafting rules by the enforcement agency rather than having legislative action for this purpose. It is anticipated that some users of this suggested ordinance will also be areas where waste will be managed, but not generated, therefore a broad authority is given and includes storage, collection, transport, transfer, processing, recovery, and disposal.*

8.02 Inspections. In order to insure compliance with the laws of this State, the ordinances of this locality and the rules and regulations authorized herein, the Enforcement Agency is authorized to inspect at reasonable times, all phases of solid waste management within this locality.

COMMENT: *As shown in Section 7, permits are issued conditioned upon observance of State and local law, this ordinance and rules and regulations authorized by Sections 6.03 and 8.01. Inspection is the best way to insure compliance with all the above. Conscientious inspection would allow early detection of violations and their correction.*

Amendment IV, United States Constitution provides: "The right of the people to be secure in their persons, houses, papers and effects against unreasonable search and seizures, shall not be violated, but no warrants shall issue but upon probable cause, supported by oath or affirmation, and particularly describing the place to be searched, and the person or thing to be seized." All State Constitutions have the same provision in some form. In the event of a refusal of entry, a search warrant will be the source of entry.

8.03 Notices. In all instances where such inspections reveal violations of this ordinance, the rules and regulations governing solid waste management, or the laws of this State, the Enforcement Agency shall issue written notice for each such violation, stating therein the violation or violations found, the date and time of such violation and the corrective measures to be taken, together with the time in which such corrections shall be made. All such notices shall be kept in a clearly marked file and shall be available for public inspection during regular business hours.

COMMENT: *This section is limited to violations found as the result of inspections and will not apply to any littering violations; the latter would fall into the class of law which is generally enforced by the uniformed police.*

8.04 Citations. In all notices involving permit holders where the corrective measures have not been taken within the time specified, the Enforcement Agency shall cite the violator to appear before the Director of the Administrative Department provided, however, in those cases where an extension of time will permit correction and where there is no public health hazard created by the delay, one extension of time, not to exceed the original period, may be given.

In all instances other than Section 12.01 where the inspections authorized in Section 8.02 reveal violations of the laws of this State, the ordinances of this locality, the rules and regulations in Section 8.01 or when the Enforcement Agency is aware of any such violation, the violator shall be cited to appear in the ________________ Court at a day and time shown in the citation.

COMMENT: *This provides a dual enforcement tool. The rules and regulations authorized to the Administrative Department governing permit holders are primarily to ensure economical and efficient solid waste management. Such violations can be handled through appearances before the Director of the Administrative Department. Other provisions established by State law, ordinance, or rules and regulations are designed to protect the safety, health, welfare, and the environment should carry a heavier penalty for violations. A violator of a rule involving a permit holder would be penalized by a suspension of a permit, or by a revocation. A person operating a disposal facility contrary to the ordinance would be cited to a formal court, where the sentence could be both penal and pecuniary. In the case of a defective reusable container (Section 12.01) the only penalty is the loss of the unacceptable container.*

The surrounding circumstances will include the nature of the violation, its duration and whether it was intentional or inadvertant. All these must be considered by the Commissioner in deciding what action to take.

Due process requires that the permittee receives a detailed list of the alleged violations. After receiving the list, the permittee may decide whether to appeal, correct the violations, or do nothing.

The notice, by including the corrections necessary to avoid permit revocation gives the permittee the opportunity to correct the violations. Ten days is a suggested time, and is reasonable for the alleged violator to decide if he wants to appeal, and if he so decides, to do so.

With the notice, the permittee knows exactly what the alleged violations are and what must be done to correct them. The permittee can then make an intelligent decision as to whether he feels the citation is correct, and that the permittee will make the corrections; or whether he feels the citation is incorrect, and he will appeal the decision by first requesting a hearing.

Reasonable time will depend on the nature, extent and number of violations. The time must be sufficient to allow the permittee to decide whether to correct the violations or to appeal. If the violations are extensive, the Enforcement Agency may extend the deadline for correcting the violations if the permittee has commenced the corrections, continues to process satisfactorily, and the Enforcement Agency is satisfied that the permittee is acting in good faith, and no health hazard is present, and will complete the corrections as soon as possible.

If the time limit elapses, and the permittee has not filed a request for a hearing or corrected the violations (or at least begun corrections and received an extension from the Director) then the permit is automatically revoked. Since the permittee did not request a hearing within provided, he has waived his rights. Thus the revocation is final, and the only possible recourse left to the permittee is the courts.

After the revocation of the permit, the ex-permittee is liable for the penalties. The revocation and penalty provisions of this ordinance are not mutually exclusive. The Director has the option of invoking either or both provisions.

8.04.1 Hearings. The Enforcement Agency shall appear, through its authorized personnel, and present its evidence, through the Chief Legal Officer, of the violations charged. The permit holder cited may appear in person or through his attorney and may cross-examine the Enforcement Agency witnesses prior to presenting evidence on his behalf.

COMMENT: *This is a simplified procedural matter in which the Enforcement Agency is required to bring its evidence in support of the charge set forth in the notice. This will allow the cited permit holder an opportunity to cross-examine prior to presenting his evidence. The usual administrative hearing will follow judicial procedures but will be on a less formal basis.*

8.04.2 Opinion. The Director of the Administrative Department shall decide the issue and shall, within ______ days of the conclusion of the hearing, render an opinion in writing, in which opinion he may suspend or revoke the permit or permits involved in the hearing.

COMMENT: *A realistic time limit should be set, so that the appeal can be considered prior to the decision. A long time interval should be avoided as it would encourage procrastination.*

8.05 Injunction. In all cases where the violation of this ordinance or the rules and regulations authorized herein, or the laws of this State create an immediate threat to the safety, health, welfare or environment of the residents of this locality, the Enforcement Agency shall cite the violator, stating therein the necessary corrective measures to be taken, and shall order same to begin forthwith. If such corrective measures are not taken forth, the Enforcement Agency shall notify the Chief Legal Officer of this locality who shall immediately apply to the __________ Court for an injunction prohibiting further violation as shown in the notice authorized in Section 8.03. The provision of this section shall be in addition to and not in substitution of any other section or sections.

COMMENT: *This is intended as an added safeguard where action or inaction may create an immediate threat to the safety, health, welfare, or environment of the population. An injunction may be obtained to compel action where corrections are not undertaken immediately. This section would not preclude citation to a court where penal and/or pecuniary penalties could be assessed.*

9. Solid Waste Management Advisory Board

9.01 Appointment. The majority of the Legislative Body of the locality shall appoint ________ residents of this municipality to a board, to be known as the Solid Waste Management Advisory Board, and shall fill all vacancies, however created. Any such appointee shall serve out the unexpired term of the person who is replaced.

COMMENT: *The use of an odd number is desirable to avoid a tie in voting. The ideal board would be made up of a combination of professional and lay people, drawing upon such professions as medicine, engineering, planning and law. Lay members could come from industry, solid waste management, etc. Both the Director of the Administrative Department and the Commissioner of the Enforcement Agency could be made members without voting rights. All appointments could be by the Chief Executive with the consent of the Legislative Body.*

9.02 Terms. The Solid Waste Management Advisory Board shall serve for a term of four years, provided, however, in the initial term, the first _____ named shall serve for two years, the next _____ named shall serve for three years and the last _____ named shall serve for four years.

COMMENT: *The term should correspond with the term of the appointing body or person where possible. In the latter case, the ordinance could authorize the executive to appoint members, with the consent of the Legislative Body. Staggered initial terms will avoid a too cooperative board. In a nine man board, the first two would serve two years, the next three named would serve for three years and the last four named would serve four years. All terms illustrated are initial.*

9.03 Organization – Meetings. The Advisory Board shall, within thirty days after its full appointment, hold a meeting at which it shall elect its officers and adopt by-laws governing the conduct of its business. The Board shall meet not less than one time in each quarter year. The Chief Executive or a majority of the Legislative Body or a quorum of the board may call an emergency meeting at any time.

COMMENT: *Once all members of the Advisory Board have been appointed there is a mandatory thirty-day period in which to hold the first meeting. By-laws are important in that they spell out such terms as a quorum, emergency meeting, etc. Added emergency meetings are provided for on the initiative of the Chief Executive, or a majority of the Legislative Body, or a quorum of the Advisory Board.*

9.04 Duties. The Advisory Board:
a. shall advise the Director in the preparation of the solid waste management plan, including the selection of solid waste management sites within this locality.
b. may review permit application forms and recommend revisions thereof, which shall be consistent with the terms of this ordinance.
c. shall attend all hearings called under this ordinance for the adoption, revision or revocation of rules and regulations authorized herein. It may make such recommendations to the Director as are authorized by its by-laws.
d. shall attend all public hearings called by the Director for establishing or altering rates, charges or fees required by this ordinance. It may make such recommendations to the Director as are authorized by its by-laws.
e. may attend any hearings held by the Director regarding complaints arising from the administration of this ordinance. The Advisory Board may make recommendations to the Director which, in its opinion, would alleviate the cause of such complaints.
In all such hearings, the Advisory Board shall participate through the Director only and all recommendations shall be in writing.

COMMENT: *The Advisory Board is designed to do just what the title implies. It is as valuable as it is permitted to be and should represent a cross section of the locality which it serves. No provision has been made for compensation so that anyone using the sample would be free to set out their own schedule. Usually, a board of this type will get either a nominal salary for each day served or the members will be paid all actual expenses incurred and paid.*

10. Time and Frequency of Collection

10.01 Residential. All residential solid waste shall be collected _____ times each week. No less than _____ hours shall lapse between each such collection. All collections shall be made between _____ a.m. and _____ p.m.

COMMENT: *Population density, waste generation and season will determine the frequency of collection. Dense population and heavy waste generation require frequent collection. Summer months may produce added waste in grass clippings, fruit and vegetable wastes, etc. This section could require two collections per week. Minimum collection frequency of twice within 7 days is recognized as disrupting the common house fly life cycle. The time of collection is designed to prevent noise or other annoyances at times when the majority of the population will be resting.*

10.02 Non-Residential. All non-residential solid waste shall be collected at sufficient intervals to protect the environment as set forth in the rules and regulations authorized herein. All such collections shall be scheduled so that collection vehicles do not interfere with rush-hour traffic.

COMMENT: *The variety of non-residential waste prevents detailed regulation as to frequency of collection. Environmental hazards would be the main concern here. Organic wastes subject to decomposition and vector attraction should be removed daily. Other wastes, such as paper from office buildings, need not be collected that often. All business area collections should be set, and efficiency and economy would dictate setting them, at times other than the morning and evening rush hours.*

11. Storage

11.01 Residential. The owners of all residential units shall provide approved containers with sufficient volume to store all residential solid waste generated in each such unit between collections. All residential solid waste shall be securely stored in an approved container, except as herein below provided.

COMMENT: *This provision fixes responsibility for providing an adequate number of containers with sufficient volume for residential waste storage.*

Reproduced from
best available copy.

"Approved containers" are left open for definition by rules and regulations. Such containers could be of the conventional size, rustproof, and durable material, with two handles to facilitate emptying, etc., and should include durable plastic or paper bags. Bags are particularly valuable during the summer months. "Securely" would require tight closure at all times other than when placing waste in or emptying waste from a container.

11.02 Non-Residential. All occupants of non-residential premises shall provide a sufficient number of approved containers for the storage of solid waste which they generate and shall place all such solid waste therein, other than those wastes which do not require containerized storage which shall be stored as authorized by the rules and regulations authorized in Section 6.

COMMENT: *In regulating containers for non-residential solid waste, care must be taken to avoid requiring storage of wastes which can be stored in the open. These two sections illustrate methods of fixing responsibility to provide approved containers for storage prior to collection and leave to the one responsibletherefore such as purchase or lease.*

12. Containers

12.01 Sanitation. The owners of all reusable approved containers shall maintain them and the adjacent area in a nuisance and odor free condition.

COMMENT: *The ordinance requires the use of approved containers for all wastes requiring such storage. Routine housekeeping should result in clean containers used for storage of solid waste. This section would be available as an enforcement tool for those few who will be careless in their housekeeping and also to institute effective insect and rodent control procedures.*

12.02 Defective Containers. All reusable containers incapable of meeting the definition of approved containers shall be considered waste and shall be placed in the collection vehicle by the collectors.

COMMENT: *Many localities have tried a tag method of control of container condition with little success. The usual way is to use a warning tag, which is attached to the container. If the container is reused, then a red tag is attached, informing the homeowner that it is illegal to use the container at any time after the tag date. The system here simplifies the entire process and is intended to safeguard the collection crew. This is a type of action which must be properly used in order to maintain resident cooperation.*

12.03 Residential Container Location Prior to Collection. All residential solid waste containers shall be placed at the curb (or alley) not more than _____ hours before collection. All reusable containers shall be removed from the curb (or [illegible]) _____ hours after collection.

COMMENT: *This section serves two purposes. It requires set-out by the homeowner and also serves to regulate placement of full containers and the removal of empties within a reasonable time so that full containers will be less likely to be upset by animals or vandals and empty containers will be removed promptly by the residents, thereby eliminating an unsightly row of cans before each house.*

Set-out and removal by the resident is the most economical process. The availability of funds and distance to the collection point would determine the use of this system. If used, some consideration must be given the handicapped and elderly. Some cities will provide a set-out service for that category. Others may leave it to each individual to make his own arrangement. If bulk containers are in use there may be a need for some variation, particularly where the collection truck enters the property for pick up.

13. Non-Containerized Waste

Non-bulky wastes which do not provide food or harbourage for insects and rodents may be placed at the curb for collection provided they are secured to prevent littering and do not exceed _____ lbs. in weight.

COMMENT: *This Section is sufficiently broad to include such items as newspapers, magazines, tree limbs, etc. Size would be within limits set by collection trucks. Weight limits should be set so that the collection crew will not be injured in lifting the bundles. Rules and regulations could be used for added detail, if needed.*

14. Bulky Waste

All bulky items shall be stored within the residence of the owner. The Director shall be notified by each resident of the type and location of items of bulky wastes to be collected and shall make same available for pick-up on the date schedules by the Director.

COMMENT: *The usualy bulky items will include "white goods", that is, refrigerators, washers, dryers, etc., and would include furniture, televisions and hot water tanks. "Available for pick-up" would be determined by the community and could include carry-out from within the residence. The requirement of storage within the residence would keep bulky items out of sight.*

15. Dead Animals

Any resident who has, or finds, a dead animal on his premises shall promptly notify the Director of its location and type and shall make such remains immediately available for collection as provided in Section 6.06.

COMMENT: *The purpose here is to prevent the use of the normal collection service for the disposition of dead animals, primarily for sanitation purposes. Rules and regulations could be used to provide for storage prior to pick up. Enclosure in a plastic bag would be an example of such a requirement. Needless to say, pick up should be made as soon as possible after notice is received from the resident by the Director.*

The street department would remove dead animals from the streets.

16. Collection – Residential

All residential solid waste shall be collected by the locality or the collector under contract with the locality.

COMMENT: *This section is for use in local collection as no other section covers residential collection other than the permit requirements for a generator who will dispose of his own waste.*

If private contractors are used then the contract between the locality and the contractor would set out in detail the duties and rights of the parties. In such case, the permit sections and rate regulations would apply.

17. Fees

17.01 Establishment and Payment. The Director shall establish such fees for residential solid waste collection as are necessary to meet all costs of operating and maintaining the residential solid waste management system. All such fees, including subsequent revisions thereof, shall be paid by the resident or owner of record of the property served, and shall be paid to the order of the applicable agency on a quarterly basis, not more than thirty days after the expiration of each quarter.

COMMENT: *In establishing fees it is essential that accurate cost figures be used. Of these figures, labor and equipment will represent the greater percentage, with overhead such as office space, supervisory salaries, vacation and sick pay and retirement benefits being representative of the balance. The quarterly billing system is used as it follows most water supply and waste water billing procedures. These fees could be added to those already in force.*

The fees could be paid into the general fund or into a specific account limited to solid waste management.

If general tax funds are the source of revenue for solid waste management, this section should be eliminated.

17.02 Delinquency. All unpaid fees shall become deliquent upon the expiration of the time specified in Section 17.01 and shall bear interest at _____% per annum until paid.

COMMENT: *This is a step in the process of forced collection fees for solid waste management. The fees are deemed delinquent after the expiration of the thirty day period given in the preceding section and collection is required in the subsequent action.*

The provision for interest is intended to bring to the attention of the delinquent account the fact that late payment adds to the cost of his individual solid waste management and to encourage prompt payment. Current lawful interest rates could be used as a guide here and, in no case, should the legal rate be exceeded.

17.03 Collection. The Director shall notify the Chief Legal Officer of all delinquent accounts not more than _____ days after the end of each quarter and the Chief Legal Officer shall take the necessary action to collect same. Each delinquent account shall be liable to the governing body for court costs and all cost items involved in its collection.

COMMENT: *This section would allow some time for out of court collection activities within the time limit set here. Section 17.01 creates a delinquency 30 days after the expiration of a quarter, thereby automatically limiting the time for suit. An additional thirty day period would not be too long to allow the Director to prepare his delinquency list. Present terminology places a mandatory duty upon the Chief Legal Officer to collect.*

This provision is the only one in the sample relative to delinquency of payments. Health considerations make it mandatory that solid waste management be continued even though user fees are not paid. Added provisions could be considered, including forced sale of real or personal property.

Welfare payments may have to be adjusted to include these fees.

17.04 Uncollected. All uncollected fees, after judgement, shall be placed on record in the locality where the property served is located, as any other judgement lien, and shall be released as paid.

COMMENT: *Property owners, as a rule, are a stable and reliable group. They, in turn, can protect themselves by adding the cost of solid waste management to the rental charge to their tenants.*

There is usually a debt limitation imposed on local governmental units which prevents the use of tax fund unless the debt limit has not been reached. The use of a fee will prevent restrictions imposed by the debt ceiling.

There will be instances where a judgement may be obtained and collection may be delayed or it may be impossible. By recording the judgement the possibility of payment will be increased.

17.05 Increase. No fees authorized in this ordinance shall be increased until the Director has held one public hearing thereon. No hearing shall be held before one notice thereof has been published in a newspaper of general circulation within this locality. There shall be not less than _____ days nor more than _____ days lapse between such publication and hearing.

COMMENT: *As presently states, no hearing would be required in the event that a decrease in fees would be possible*

A notice is required to advise the users of the system and permit holders that a rate increase is proposed so that any interested person can appear and be heard. The time interval between publication and hearing should be of sufficient duration to allow full participation.

A wide publication of the proposed rate change is desirable. Added media coverage could be used to assure a fully informed public.

17.06 Hearings. The Director shall preside at all hearings concerning fee increases and shall open and close the hearing. Any system user or permit holder present and wishing to be heard shall be recognized by the Director, who shall give the user or permit holder the opportunity to make a consise statement presenting his views.

COMMENT: *This section is intended to provide some order to the hearing by authorizing the Director to open and close the session. He would also be authorized to recognize those who wish to be heard and to regulate the time allocated for a concise statement.*

18. Insurance

18.01 Performance Bonds. All persons who contract with this governing body to manage solid waste shall furnish performance bonds conditioned upon the faithful performance of their agreements. All such bonds shall be written by an insurance company licensed to transact business in this State and shall be for a sum of not less than one half of the annual sum paid to each such contractor. No such bond shall exceed 100% of the annual contract payment to each contractor. Each performance bond shall be for a period equal to the initial contract term, or any extension thereof.

COMMENT: *Performance bonds are usually required by State law to protect the governing body in the event a contractor defaults. Each performance bond will have a time limit set out in which a claim must be reported to the company. Failure to notify the company in that time will void the policy. All insurance policies should be reviewed periodically so that the rights of the locality can be protected.*

This section could be expanded to require a performance bond of all permit holders who discontinue their activities before the expiration date of the permit, thereby assuring continuance of the activities covered thereby.

18.02 Payment Bonds. Each contractor referred to above shall, not less than ten (10) days after the execution of each contract, deliver to the governing body proof of a payment bond executed by a surety company licensed to transact business in this State, guaranteeing payment of wages to all employees of the contractor and the cost of all supplies, materials and insurance premiums required in fulfilling each contract.

COMMENT: *This section is intended to safeguard all wages due employees of a contractor, as well as the payment of materials and supplies used in the performance of the contract.*

18.03 Liability Insurance. All contractors and permit holders under the provisions of this ordinance shall furnish proof to the governing body of liability insurance covering all aspects of their activities under this ordinance. No personal injury policy shall be for less than $________ per person or $________ per accident. No property damage policy shall be for less than $________ per accident. All policies required by this ordinance shall have a minimum cancellation period of not less than ______ days after receipt in writing of the notice of cancellation by the governing body.

COMMENT: *Care should be exercised in setting policy limit requirements which will protect the general public. State financial responsibility limits for motor vehicles should not be considered as guides as they are regarded as too low. Workmen's Compensation by a private carrier would not be covered by this section as it is now written.*

19. Permit Renewal

Any permit holder desiring to renew an existing permit shall complete and submit to the Director of the Administrative Department an application therefor not more than ______ days nor less than ______ days before the expiration date thereof and shall tender with each application form such permit fees as are herein below required.

COMMENT: *Sufficient time should be allowed to process a renewal application to provide another source for the activity, if the renewal is denied. It will also give the Director time to inspect equipment and sites.*

20. Permit Fees

Each application for a permit, or renewal application, shall be accompanied by a certified check or money order in the following amounts:

a. 7.01 $__________ (Self-Management)
b. 7.02 $__________ (Storage)
c. 7.03 $__________ (Collection)
d. 7.04 $__________ (Transfer)
e. 7.05 $__________ (Transport)

f. 7.06 $__________(Incineration)
g. 7.07 $__________(Sanitary Landfill)
h. 7.08 $__________(Resource Recovery)
All fees required by this section shall be placed in the ______________ fund of this governmental agency.

COMMENT: *Fees should be realistic and should bear a reasonable relation to the expenses incurred by the governmental agency for processing applications. It may be desirable to provide an added clause making all such fees non-returnable.*

21. Appeals

Any person who feels aggrieved by any action of the Director of the Administrative Department or the Commissione of the Enforcement Agency may within ______ days of the act for which redress is sought, appeal to the Advisor Board, in writing, setting forth in a concise statement the act being appealed and the ground for its reversal.

The Advisory Board shall, within ______ days following the receipt of each written appeal schedule a hearing date and notify the appellant and the Director of the Administrative Department or Commissioner of the Enforcement Agency in writing of the date and time of the scheduled hearing. The appellant may appear on his own behalf, or through counsel, and may present his witnesses. The Director of the Administrative Department or Commissioner of the Enforcement Agency may present rebuttal testimony and witnesses.

The Advisory Board shall within ______ days after the hearing notify the Director of the Administrative Department or Commissioner of the Enforcement Group of its decision and recommendations and shall forward one copy to the appellant.

The Director of the Administrative Department or Commissioner of the Enforcement Agency shall within ______ days of the receipt of the decision of the Advisory Board, either approve or disapprove the decision and recommendation of the Advisory Board and shall forward a copy to the appellant.

COMMENT: *Appeals to an Advisory Board should be encouraged as this could help relieve congested courts of their case loads and provide for rapid resolution of the question. It should be emphasized, however, that any decision of the Board is binding upon the governmental agency. In the proceeding, the Administrative Department makes the final decision. Disadvantages of such appeals are the absence of power of a board to compel the attendance of witnesses or the production of evidence.*

22. Appeals, Alternative

Any person who feels aggrieved by any act of the Administrative Department or Enforcement Agency may waive the provision of Section 21, and within the time limit specified therein, appeal directly to the Court of __________.

During all appeals authorized herein, the opinion of the Director shall remain in full force and effect.

COMMENT: *The Administrative Procedures Act of the State should be consulted and followed for the details of appeals procedures, including time restraints. Each State will have a court of broad initial jurisdiction which should be authorized to hear appeals from administrative action.*

23. Computation of Time

The time within which an act is required by law to be done shall be computed by excluding the first and including the last day; except that when the last day falls on Sunday or a legal holiday, then the Act may be done on the next succeeding day which is not Sunday or a legal holiday.

When a public office in which an act, required by law, is to be performed is closed to the public for the entire day which constitutes the last day for doing such act, or before its usual closing time on such day, then such act may be performed on the next succeeding day which is not a Sunday or a legal holiday.

COMMENT: *This section will set a standard for actual time intervals as all notices to correct deficiencies will have to carry a definite time limit. Other provisions, as in permit applications require a definite time period for action.*

f. 7.06 $__________(Incineration)
g. 7.07 $__________(Sanitary Landfill)
h. 7.08 $__________(Resource Recovery)
All fees required by this section shall be placed in the ______________ fund of this governmental agency.

COMMENT: *Fees should be realistic and should bear a reasonable relation to the expenses incurred by the governmental agency for processing applications. It may be desirable to provide an added clause making all such fees non-returnable.*

21. Appeals

Any person who feels aggrieved by any action of the Director of the Administrative Department or the Commissioner of the Enforcement Agency may within ______ days of the act for which redress is sought, appeal to the Advisory Board, in writing, setting forth in a concise statement the act being appealed and the ground for its reversal.

The Advisory Board shall, within ______ days following the receipt of each written appeal schedule a hearing date and notify the appellant and the Director of the Administrative Department or Commissioner of the Enforcement Agency in writing of the date and time of the scheduled hearing. The appellant may appear on his own behalf, or through counsel, and may present his witnesses. The Director of the Administrative Department or Commissioner of the Enforcement Agency may present rebuttal testimony and witnesses.

The Advisory Board shall within ______ days after the hearing notify the Director of the Administrative Department or Commissioner of the Enforcement Group of its decision and recommendations and shall forward one copy to the appellant.

The Director of the Administrative Department or Commissioner of the Enforcement Agency shall within ______ days of the receipt of the decision of the Advisory Board, either approve or disapprove the decision and recommendation of the Advisory Board and shall forward a copy to the appellant.

COMMENT: *Appeals to an Advisory Board should be encouraged as this could help relieve congested courts of their case loads and provide for rapid resolution of the question. It should be emphasized, however, that any decision of the Board is binding upon the governmental agency. In the proceeding, the Administrative Department makes the final decision. Disadvantages of such appeals are the absence of power of a board to compel the attendnace of witnesses or the production of evidence.*

22. Appeals, Alternative

Any person who feels aggrieved by any act of the Administrative Department or Enforcement Agency may waive the provision of Section 21, and within the time limit specified therein, appeal directly to the Court of __________.

During all appeals authorized herein, the opinion of the Director shall remain in full force and effect.

COMMENT: *The Administrative Procedures Act of the State should be consulted and followed for the details of appeals procedures, including time restraints. Each State will have a court of broad initial jurisdiction which should be authorized to hear appeals from administrative action.*

23. Computation of Time

The time within which an act is required by law to be done shall be computed by excluding the first and including the last day; except that when the last day falls on Sunday or a legal holiday, then the Act may be done on the next succeedingday which is not Sunday or a legal holiday.

When a public office in which an act, required by law, is to be performed is closed to the public for the entire day which constitutes the last day for doing such act, or before its usual closing time on such day, then such act may be performed on the next succeeding day which is not a Sunday or a legal holiday.

COMMENT: *This section will set a standard for actual time intervals as all notices to correct deficiencies will have to carry a definite time limit. Other provisions, as in permit applications require a definite time period for action.*

24. Title to Waste

In the absence of an agreement to the contrary, title to the solid waste shall vest in the owner of each management activity or facility in which the solid waste is placed.

COMMENT: *This section is intended to pass title to waste from the generator to an identifiable person throughout its management. This will help fix responsibility for management and will avoid confusion as to ownership of recovered items. It will also avoid conflicting claims in the event a resident inadvertently includes an item of value in his waste, as such item would be neither unwanted, discarded or useless. Resource recovery will give added emphasis to the need for legal title to solid waste, particularly where large volumes are involved, therefore this section clearly fixes ownership at any management step.*

25. Prohibited Activities

25.01 Dead Animals. It shall be unlawful to place any dead animal, or parts thereof, in a container for collection without the consent of the Director, provided, however, this section shall not apply to animal parts from food preparation for human consumption.

COMMENT: *This section is to encourage the use of the dead animal collection required in Sections 6.06 and 15. The exclusion includes all food preparation, including residential and commercial activity, such as restaurants.*

25.02 Littering. It shall be unlawful to place, or allow to be placed, any solid waste upon the roads, streets, public or private property within this municipality contrary to the provisions of this ordinance.

COMMENT: *Proper solid waste management requires regulated disposal. This section and Section 25.08, prohibiting dumps, are intended to eliminate litter and promiscuous dumping. The penalties provided in Section 26 can be used to discourage either practice. "Allow" is included for the protection of a property owner whose consent is not given to a person dumping or littering.*

25.03 Acts Contrary to Ordinance. It shall be unlawful to store, collect, transport, transfer, recover, incinerate, or dispose of any solid waste within the boundaries of this locality contrary to the provisions of this ordinance.

COMMENT: *This Section declares all aspects of solid waste management illegal unless done in conformity with the provisions of the ordinance. Any person who stores, collects, transports, transfers, recovers, incinerates, or disposes of solid waste must have the required permits and must conform to State and local laws and the rules and regulations authorized in this ordinance. Although residential solid waste has minimal regulation here, legislative bodies may want to go into greater detail.*

In the event that a process or activity for solid waste management is introduced in the locality, the user will have to set up a permit application and include it in this and other applicable sections.

25.04 Vehicle Construction. It shall be unlawful to transport any solid waste in any vehicle which permits the contents to blow, sift, leak or fall therefrom.

COMMENT: *This is the only provision which sets standards for vehicle construction and is a requirement usually found in State laws.*

25.05 No Interference with Authorized Solid Waste Management. It shall be unlawful for any person to interfere with any employee of this locality or any employee of a contractor while in the performance of their duties as authorized by this ordinance.

COMMENT: *Inspections before and after issuance of permit are necessary to insure compliance with the ordinance. This Section is the basis for penalizing interference with any person acting under the authority of the ordinance.*

25.06 Scavenging Prohibited. It shall be unlawful for any person to scavenge any solid waste within the boundaries of this locality.

COMMENT: *Solid waste management cannot be effective if casual pickers are permitted in any step in the process, whether pre-collection activity from containers at the curb or at an incinerator or sanitary landfill. Controlled recovery should be encouraged at any logical step of proper solid waste management.*

25.07 False Information. It shall be unlawful for any person to make any false statement in any application required by this ordinance.

COMMENT: *This section provides a penalty for false information given on any application required by the ordinance. Conviction would require a showing that the false information was provided deliberately but would not include innocent or erroneous information. The Administrative Department would also have the inherent right to revoke any permit or permits involved in the applications, as a false statement vitiates such matters.*

25.08 Dumps Prohibited. It shall be unlawful for any person to use or operate a dump.

COMMENT: *The intent of the ordinance is set forth in Section 2 and will be defeated unless all dumps are converted to sanitary landfills or are eliminated.*

25.09 Burning Prohibited. It shall be unlawful for any person to burn solid waste in any manner other than in a duly authorized incinerator.

COMMENT: *Air pollution control can not be effective unless open burning is eliminated. The ordinance requires a permit for all incinerators, thereby insuring the installation and use of pollution control measures, including the disposal of incinerator residue and proper treatment of quench waters. The ban here would include leaf burning, therefore the added waste volume will have to be considered in the plan requirements of Section 6.01. This section does not prohibit the use of a fireplace or outdoor grill of residences, unless barred by a separate law.*

25.10 Animal Feeding. It shall be unlawful for any person to engage in the feeding of food waste to animals for commercial purposes.

COMMENT: *State law usually regulates food waste (garbage) feeding to animals, usually swine, under controlled conditions. If such feeding is permitted, those regulations shall be followed.*

25.11 Illegal Use of Permit Number. It shall be unlawful to display any permit number unless the person displaying such number or numbers holds a valid permit or permits therefor.

COMMENT: *A duly issued permit may be suspended or revoked by the Director of the Administrative Department. This Section would make it illegal either to use a fictitious permit number or to continue the display of permit number after suspension or revocation. Permit numbers are needed to identify and regulate solid waste management.*

25.12 Hazardous Waste. No person shall place any hazardous waste in any container for collection, transport, processing or disposal until the Enforcement Agency has approved the method of storage, transport, processing, or disposal.

COMMENT: *This section is intended to identify and regulate hazardous waste to protect the health of the community and to protect people engaged in solid waste management. Experience will allow some standardization in proper management of hazardous wastes.*

26. Penalties

Any person convicted of a violation of this ordinance, or the rules and regulations authorized herein, shall be subject to a fine of not more than $______ or imprisonment in the county jail for not more than ______ months, or both.

COMMENT: *The Court enforcing an ordinance will have limits in pecuniary and penal punishment, therefore that limitation must be considered in setting forth sums and sentences. Penal institutions may be a county jail, a municipal jail or a workhouse. The maximum range should be high enough to discourage violation and a penalty section should allow some discretion to the judge.*

27. Repealer

The following ordinances of this locality are hereby repealed: ______________________;

COMMENT: *All ordinances which are to be replaced by this ordinance should be specifically listed, based upon careful evaluation of each to be repealed. The use of an omnibus repealer should be avoided as it may prove too broad.*

28. Savings Clause

Nothing in this ordinance shall be deemed to affect, modify, amend or repeal any provisions of an ordinance administered by the Administrative Department or Enforcement Agency or any other department, board, commission or agency of this locality.

COMMENT: *If no existing ordinances are to be repealed and if the Solid Waste Management Ordinance is not to affect any existing ordinances or authority created by existing ordinances, the above provision would be useful in showing such intent.*

29. Severability Clause

The provisions of this ordinance are severable, and if any provision or part thereof shall be held invalid or unconstitutional or inapplicable to any person or circumstance, such invalidity, unconstitutionalty or inapplicability shall not affect or impair the remaining provisions of this ordinance.

COMMENT: *If a court strikes out a part of the ordinance prompt legislative action should be taken to enact provisions to fill the void.*

30. Effective Date

This Act is hereby declared an emergency provision to protect the health and welfare of the inhabitants of this locality and shall take effect immediately upon its passage, provided, however, those sections requiring permits shall not apply to existing facilities for a period of ______ months after said effective date.

COMMENT: *In establishing an effective date for the ordinance sufficient time must be given so that existing facilities can be brought within the terms set forth. Dumps could be closed in a short time but would require a longer period for conversion to a sanitary landfill.*

24. Title to Waste

In the absence of an agreement to the contrary, title to the solid waste shall vest in the owner of each management activity or facility in which the solid waste is placed.

COMMENT: *This section is intended to pass title to waste from the generator to an identifiable person throughout its management. This will help fix responsibility for management and will avoid confusion as to ownership of recovered items. It will also avoid conflicting claims in the event a resident inadvertently includes an item of value in his waste, as such item would be neither unwanted, discarded or useless. Resource recovery will give added emphasis to the need for legal title to solid waste, particularly where large volumes are involved, therefore this section clearly fixes ownership at any management step.*

25. Prohibited Activities

25.01 Dead Animals. It shall be unlawful to place any dead animal, or parts thereof, in a container for collection without the consent of the Director, provided, however, this section shall not apply to animal parts from food preparation for human consumption.

COMMENT: *This section is to encourage the use of the dead animal collection required in Sections 6.05 and 15. The exclusion includes all food preparation, including residential and commercial activity, such as restaurants.*

25.02 Littering. It shall be unlawful to place, or allow to be placed, any solid waste upon the roads, streets, public or private property within this municipality contrary to the provisions of this ordinance.

COMMENT: *Proper solid waste management requires regulated disposal. This section and Section 25.09, prohibiting dumps, are intended to eliminate litter and promiscuous dumping. The penalties provided in Section 26 can be used to discourage either practice. "Allow" is included for the protection of a property owner whose consent is not given to a person dumping or littering.*

25.03 Acts Contrary to Ordinance. It shall be unlawful to store, collect, transport, transfer, recover, incinerate, or dispose of any solid waste within the boundaries of this locality contrary to the provisions of this ordinance.

COMMENT: *This Section declares all aspects of solid waste management illegal unless done in conformity with the provisions of the ordinance. Any person who stores, collects, transports, transfers, recovers, incinerates, or disposes of solid waste must have the required permits and must conform to State and local laws and the rules and regulations authorized in this ordinance. Although residential solid waste has minimal regulation here, legislative bodies may want to go into greater detail.*

In the event that a process or activity for solid waste management is introduced in the locality, the user will have to set up a permit application and include it in this and other applicable sections.

25.04 Vehicle Construction. It shall be unlawful to transport any solid waste in any vehicle which permits the contents to blow, sift, leak or fall therefrom.

COMMENT: *This is the only provision which sets standards for vehicle construction and is a requirement usually found in State laws.*

25.05 No Interference with Authorized Solid Waste Management. It shall be unlawful for any person to interfere with any employee of this locality or any employee of a contractor while in the performance of their duties as authorized by this ordinance.

COMMENT: *Inspections before and after issuance of permit are necessary to insure compliance with the ordinance. This Section is the basis for penalizing interference with any person acting under the authority of the ordinance.*

25.06 Scavenging Prohibited. It shall be unlawful for any person to scavenge any solid waste within the boundaries of this locality.

COMMENT: *Solid waste management cannot be effective if casual pickers are permitted in any step in the process, whether pre-collection activity from containers at the curb or at an incinerator or sanitary landfill. Controlled recovery should be encouraged at any logical step of proper solid waste management.*

25.07 False Information. It shall be unlawful for any person to make any false statement in any application required by this ordinance.

COMMENT: *This section provides a penalty for false information given on any application required by the ordinance. Conviction would require a showing that the false information was provided deliberately but would not include innocent or erroneous information. The Administrative Department would also have the inherent right to revoke any permit or permits involved in the applications, as a false statement vitiates such matters.*

25.08 Dumps Prohibited. It shall be unlawful for any person to use or operate a dump.

COMMENT: *The intent of the ordinance is set forth in Section 2 and will be defeated unless all dumps are converted to sanitary landfills or are eliminated.*

25.09 Burning Prohibited. It shall be unlawful for any person to burn solid waste in any manner other than in a duly authorized incinerator.

COMMENT: *Air pollution control can not be effective unless open burning is eliminated. The ordinance requires a permit for all incinerators, thereby insuring the installation and use of pollution control measures, including the disposal of incinerator residue and proper treatment of quench waters. The ban here would include leaf burning, therefore the added waste volume will have to be considered in the plan requirements of Section 6.0. This section does not prohibit the use of a fireplace or outdoor grill of residences, unless barred by a separate law.*

25.10 Animal Feeding. It shall be unlawful for any person to engage in the feeding of food waste to animals for commercial purposes.

COMMENT: *State law usually regulates food waste (garbage) feeding to animals, usually swine, under controlled conditions. If such feeding is permitted, those regulations shall be followed.*

25.11 Illegal Use of Permit Number. It shall be unlawful to display any permit number unless the person displaying such number or numbers holds a valid permit or permits therefor.

COMMENT: *A duly issued permit may be suspended or revoked by the Director of the Administrative Department. This Section would make it illegal either to use a fictitious permit number or to continue the display of permit number after suspension or revocation. Permit numbers are needed to identify and regulate solid waste management.*

25.12 Hazardous Waste. No person shall place any hazardous waste in any container for collection, transport, processing or disposal until the Enforcement Agency has approved the method of storage, transport, processing, or disposal.

COMMENT: *This section is intended to identify and regulate hazardous waste to protect the health of the community and to protect people engaged in solid waste management. Experience will allow some standardization in proper management of hazardous wastes.*

26. Penalties

Any person convicted of a violation of this ordinance, or the rules and regulations authorized herein, shall be subject to a fine of not more than $______ or imprisonment in the county jail for not more than ______ months, or both.

COMMENT: *The Court enforcing an ordinance will have limits in pecuniary and penal punishment, therefore that limitation must be considered in setting forth sums and sentences. Penal institutions may be a county jail, a municipal jail or a workhouse. The maximum range should be high enough to discourage violation and a penalty section should allow some discretion to the judge.*

27. Repealer

The following ordinances of this locality are hereby repealed: ______________________________.

COMMENT: *All ordinances which are to be replaced by this ordinance should be specifically listed, based upon careful evaluation of each to be repealed. The use of an omnibus repealer should be avoided as it may prove too broad.*

28. Savings Clause

Nothing in this ordinance shall be deemed to affect, modify, amend or repeal any provisions of an ordinance administered by the Administrative Department or Enforcement Agency or any other department, board, commission or agency of this locality.

COMMENT: *If no existing ordinances are to be repealed and if the Solid Waste Management Ordinance is not to affect any existing ordinances or authority created by existing ordinances, the above provision would be useful in showing such intent.*

29. Severability Clause

The provisions of this ordinance are severable, and if any provision or part thereof shall be held invalid or unconstitutional or inapplicable to any person or circumstance, such invalidity, unconstitutionality or inapplicability shall not affect or impair the remaining provisions of this ordinance.

COMMENT: *If a court strikes out a part of the ordinance prompt legislative action should be taken to enact provisions to fill the void.*

30. Effective Date

This Act is hereby declared an emergency provision to protect the health and welfare of the inhabitants of this locality and shall take effect immediately upon its passage, provided, however, those sections requiring permits shall not apply to existing facilities for a period of ______ months after said effective date.

COMMENT: *In establishing an effective date for the ordinance sufficient time must be given so that existing facilities can be brought within the terms set forth. Dumps could be closed in a short time but would require a longer period for conversion to a sanitary landfill.*

FOOTNOTES

1. J.F. Hudson, F.P. Gross, D.G. Wilson, and D.H. Marks. Evaluation of Policy-Related Research in the field of Municipal Solid Waste Management. Research Report R74-56, Department of Civil Engineering, Massachusetts Institute of Technology. 1974.

2. American Public Works Association. Solid Waste Collection Practice. Chicago: Public Administration Service, 1975.

3. Office of Solid Waste Management Programs, U.S. Environmental Protection Agency, Decision-Makers Guide in Solid Waste Management. Washington: U.S. Environmental Protection Agency, 1976 (SW-500).

4. J.F. Hudson, et al. op.cit.; American Public Works Association. op.cit.; Office of Solid Waste Management. Ibid.

5. E.S. Savas. "Municipal Monopolies vs. Competition in Delivering Urban Services." in W. Hawley and D. Rogers (ed.) Improving the Quality of Urban Management, Beverly Hills: Sage Publications, 1974.

6. J.M. McFarland; C.R. Glassey; P.H. McGauhey; D.L. Brink; S.A. Klein; and C.G. Golueke. Comprehensive Studies of Solid Wastes Management. Final Report. Report 72-3, Sanitary Engineering Research Laboratory, College of Engineering and School of Public Health, University of California, Berkeley, 1972.

7. J.D. Sartor and G.B. Boyd. Water Pollution Aspects of Street Surface Contaminants. EPA-R2-72-081. Washington: U.S. Government Printing Office, 1972.

8. R.M. Wolcott and B.W. Vincent. The Relationship of Solid Waste Storage Practices in the Inner City to the Incidence of Rat Infestation and Fires. EPA/53-/SW/150, May 1975.

9. J.F. Hudson. Demand for Municipal Services: Measuring the Effect of Service Quality. Research Report R75-21, Department of Civil Engineering, Massachusetts Institute of Technology, 1975.

10. Office of Solid Waste Management Programs, op.cit. (hereafter OSWMP).

11. D.R. Brunner and D.J. Keller. Sanitary Landfill Design and Operation. Washington: U.S. Government Printing Office, 1972 (SW-65ts).

    American Society of Civil Engineers, Sanitary Landfill, ASCE Manual #39, New York: ASCE, 1976 (new edition, revised).

12. D. Brunner and D.J. Keller, op.cit.

    ASCE, op.cit.

13. See the EPA Model Ordinance included at the end of this chapter.

14. National Association of Counties. *Basic Issues on Solid Waste Management Affecting County Government*. Washington, D.C.: EPA, May 1973.

15. SCS Engineers, Inc. *Analysis of Source Separation Collection of Recyclable Solid Waste -- Volume 1. Separate Collection Studies* and *Volume 2. Collection Center Studies*. EPA/530/SW-95c, 1974.

16. *Ibid*.

17. J.C. Curry, and J. LaBella. "Authority of Municipalities to Regulate and Finance Solid Waste Management." Unpublished mimeograph, n.d. may be available from OSWMP.

18. Cambridge, Massachusetts, 1971. Personal experience. Program was never implemented, but did consider such variations as price supports, to insure that the waste was collected for recycling under all situations.

19. For example, Pasadena, California, requires inspections before issuing certificates of occupancy after any change in tenant or owner of a property. Solid waste inspections could easily be included.

20. Stone (Ralph) and Company, Inc. *A Study of Solid Waste Collection Systems Comparing One-Man with Multi-Man Crews*. Public Health Service Publication No. 1892. Washington: U.S. Government Pringing Office, 1969 (S.W.-9c; AIM 65).

21. *Compost Science, Journal of Waste Recycling*. Emmaus, Pa.: Rodale Press. 18049

22. Hudson, Gross, Wilson, Marks. *op.cit.* (hereafter MIT)

23. OSWMP, MIT, American Public Works Association, *op.cit*. (hereafter APWA).

24. OSWMP

25. M. Stragier and D.L. McGaw. *Mechanized Residential Solid Waste Collection*. City of Scottsdale, Arizona, 1973.

26. OSWMP, MIT.

27. D.E. Ecke and D.D. Linsdale. "Fly and Economic Evaluation of Urban Refuse Systems -- Part I. Control of Green Blow Flies (Phaenicia) by Improved Methods of Residential Refuse Storage and Collection." *California Vector Views* 14(4): 19-27, April 1967.

    D.E. Ecke; D.D. Linsdale; and K.E. White. "Migration of Green Blow Fly Larvae from Six Refuse Container Systems." *California Vector Views* 12(8): 35-42, August 1965.

28. E.S. Savas, *op.cit*.

29. S. Woodley. "Metered Bags: An Answer to Rising Refuse Collection Costs." *Public Works Magazine* 105(8): 81, 98, August 1974.

30. J.F. Hudson. *op.cit.*

31. SCS Engineers, Inc. *op.cit.*

32. *Ibid.*

33. OSWMP.

34. MIT.

35. MIT.

36. W.C. Finnie. "Field Experiments in Litter Control." *Environment and Behavior*. 5(2): 123-144, June 1973.

37. Keep America Beautiful, Inc. *Final Report: Action Research Model*. New York: Keep America Beautiful, 1975.

38. MIT.

39. Stone (Ralph) and Company, Inc. *Forecasts of the Effects of Air and Water Pollution Controls on Solid Waste Generation*. EPA/670/2-74/o95, 1974.

40. B. Thompson and I. Zandi. "Future of Sanitary Landfill." *J.Env.Eng. Div*., Proceedings ASCE. 101(EE1), February 1975.

41. F.P. Gross. *Issues in the Regionalization of Solid Waste Management Planning*. Research Report R75-26, Department of Civil Engineering, MIT, 1975.

42. C. Binkley. "Regional Environmental Management: Case Study of a Resource Recovery Operation." Presented at the Northeast Regional Science Association Meeting, April 19, 1975.

43. J.F. Hudson, *op.cit.*

44. Wolcott and Vincent, *op.cit.*

45. J.F. Hudson, *op.cit.*

46. OSWMP.

J.V. Compton. *Effort and Incentive Determinant of Trash Recycling Behavior*. Unpublished Ph.D., Claremont Graduate School, 1972.

47. R.P. Lowman. *Recycling Refuse: The Effect of the Foot-in-the-Door Technique on Attitude and Repetitive Behavior*. Unpublished Ph.D. Thesis, Claremont Graduate Schoo, 1973.

48. Keep America Beautiful, Inc. *op.cit.* (hereafter KAB).

49. OSWMP.

50. SCS Engineers, Inc. *op.cit.*

51. OSWMP.

52. National Association of Counties Research Foundation. *Guidelines for Local Governments on Solid Waste Management*. Public Health Service Publication No. 2084. Washington: U.S. Government Printing Office, 1971 (SW-17c).

R.M. Clark and J.L. Gillean. "Systems Analysis and Solid Waste Planning." *J. Env. Eng. Div.*, Proc. ASCE 100(EE1): 7-24, February 1974.

53. National Solid Waste Management Association, 1730 Rhode Island Avenue, N.W., Washington, D.C. 20036.

54. Write Richard Sullivan, APWA, 1313 E. 60th, Chicago, Illinois 60637. personal communication.

55. MIT; OSWMP; APWA; and

ACT Systems Inc. *Residential Collection Systems Study*. (Final Report to Systems Management Division, OSWMP, U.S. EPA). Winter Park, FL: ACT Systems, Inc., 1974.

National Solid Waste Management Association. *1972 Annual Listing of NSWMA-Rated Apartment/Institutional Stationary Compactors*. Washington: NSWMA, 1973. (annual updates)

56. National Sanitation Foundation. *Standard 31, Polyethylene Refuse Bags*, and *Standard 32, Paper Refuse Sacks*. Ann Arbor: NSF, 1970.

57. EPA, *Final Guidelines for Storage and Collection of Residential, Commercial, and Institutional Solid Waste* (40 CFR 243), February 1976.

58. Anonymous. "Refuse Bags." *Consumer Reports.* 43(1): 18-21, January 1973.

59. Bradbury Associates, Inc. *The Atlanta Household Refuse Compactor Demonstration Project*. Atlanta: Bradbury Associates, 1973. (Available from Whirlpool Corporation, Benton Harbor, Michigan 49002.)

60. Stragier, *op.cit*.

61. *Solid Waste Management*, 461 Eighth Avenue, New York, New York 10001.

62. Office of Solid Waste Management Programs, U.S. Environmental Protection Agency, 401 M Street, S.W., Washington, D.C. 20460.

63. American Public Works Association, 1313 E. 60th, Chicago, Illinois 60637.

64. Governmental Refuse Collection and Disposal Association, 2333 W. Third Street, Los Angeles, California 90057.

65. Contact them directly through the Yellow Pages.

66. American Society of Civil Engineers, 345 E. 47th St., New York, NY 10017.

67. National Center for Resource Recovery, Inc., 1211 Connecticut Avenue, N.W., Washington, D.C. 20036.

68. Keep America Beautiful, Inc., 99 Park Avenue, New York, NY 10016.

69. M.D. Powell; B.P. Fiedleman; M.J. Roe (NACo), *Digest of Selected Local Solid Waste Management Ordinances*, Cincinnati: U.S. EPA, 1972 (SW-38c).

SECTION VIII

SUBDIVISION ORDINANCES FOR LOCAL ENVIRONMENTAL REVIEW

ENVIRONMENTAL IMPACT REVIEWS ON THE LOCAL LEVEL

In 1969, Congress passed the National Environmental Policy Act (NEPA), which for the first time established environmental concerns as a high priority in the review of all federally funded actions affecting the human environment. The major tool of NEPA is the Environmental Impact Statement (EIS), which must be written whenever a project is likely to have "significant" environmental impacts. The EIS analyzes the project's expected environmental impacts, as well as those of the available alternatives. Many states have passed environmental policy acts modeled after NEPA, extending the requirement for preparing EISs to projects not covered under the federal law.

Seven years after the passage of NEPA, the EIS process is still controversial: while on the one hand it has raised the level of understanding of man's impact on the environment, and has cuased unwisely planned projects to be revised or cancelled, its procedural requirements are formidable, and the expense of creating an EIS can be large. Although the Council on Environmental Quality, which reviews EISs prepared under NEPA, has frequently called for more succinct without needless detail, most EISs remain exceedingly complex: agencies preparing statements tend to use highly detailed analyses in an effort to shield themselves against any legal challenge that their analysis of controversial issues might be inadequate. Thus, because of the procedural, financial, and technical difficulty of producing a good EIS, they are undertaken with reluctance.[1]

Increasingly, local governments are showing an interest in long range community planning that takes account of natural resource limitations, but they are often discouraged from modeling environmental reviews of their own development projects after NEPA. The benefits of environmental reviews tend to be outweighed in their minds by what appears to be an intimidating amount of technical and legal analysis.

Each of the improvements to municipal environmental ordinances described in the previous chapters can be of value if implemented alone, but communities may wish to go beyond a piecemeal approach to improving the environment and attempt to design a comprehensive process. Unfortunately, a study conducted by EPA has shown that local levels of government generally prefer not to embark on long term review processes--they prefer, whenever possible, to pass a one-shot ordinance aimed at a specific purpose, something that will not require updating or case by case reviews.[2]

The natural resource inventory and subdivision review process described here is designed to gain, for local governments, many of the benefits of full-scale environmental impact statements with minimum expenditures of time and money--both on the town's part and on the developer's. It enables several spheres of environmental concern to be brought together efficiently; used in conjunction with the approaches to environmental quality developed in the previous chapters of this report, it can make enviornmentally sound land development better understood and easier to attain.

In essence, the technical content of the process it twofold, being comprised of (1) a natural resource inventory, and (2) performance standards based on the capacity of the land to sustain various kinds of local development. Together they form a "cookbook" EIS process, combining, in a simplified way, the first stage of the federal EIS process--the environmental impact analysis of a project--with essentially ready-make answers to how a particular project will affect the long term community goals. Rather than have the developer conduct the entire process of the environmental review, this process puts the relatively small burden of research on the town, and allows the developer the opportunity to improve the quality of the research he desires.

Goals and Methods

Communities experiencing significant growth are aware both of the costs of servicing new development, and of the despoiling of environmental amenities that often accompanies it. Traditional land use controls such as zoning often fail to optimize service provisions and environmental values because they are not linked directly to the physical conditions on site, conditions that influence the costs of development both to the community and to the developer. Environmental impact assessment processes seek to correct this by requiring review of actual site conditions whenever development occurs.

The most direct and practical way to design useful local environmental impact assessments so far identified is through the use of a natural resource inventory, supported by locally adopted performance standards or environmental regulations in a subdivision or site review process.

The natural resource inventory is a mapping, to varying degrees of precision, of environmental factors of concern to local officials, planners and citizens. While the number of factors that can be mapped in a local ordinance is nearly unlimited, only a few are usually necessary to identify areas of potentially major environmental disturbance, or to locate areas where development can best be supported. Perhaps the most important factors to be mapped in most areas of the country are those having to do with water pollution control, both sanitary waste management and stormwater management.

Maps of soil types, bedrock formations, aquifer recharge areas, minimum depth to groundwater, and local surface hydrology are valuable for determinging where on-site waste disposal is practical and efficient, and where it is not. Maps of soil types, vegetation and land use, slope, and surface hydrology are necessary to determine where surface runoff is likely to cause erosion and sedimentation problems. Maps of flood plains (100 year boundaries), identify where development should be most stringently controlled to prevent flood damage.[3]

Performance standards or environmental regulations must then be defined to control the impacts of development on the environmental factors identified and mapped by the natural resource inventory. It is essential that towns not only decide what they want to map, i.e., what environmental factors are meaningful in reviewing projects (and they ought to be as simple as possible), but also develop performance standards or environmental regulations that give firm and clear guidelines for review (again, the simpler the better).

The natural resource inventory and the adopted performance standards form a document used directly by developers in the preparation of their environmental impact assessments. In the process suggested here, hardship cases and special circumstances can be taken into account in enforcement and for granting of variances.

The following procedures are typical for a subdivision review process.[4] In order to get his plat approved, a developer first locates his property on a full or partial set of environmental maps, as required by the board, overlaying their information on his property. He then reviews the regulations to see if his plans conflict with any of them. He is free to hire experts to determine if the data on the maps is accurate for his site--many do, especially if development restrictions seem indicated. He then presents all this data to the board. The developer is not being asked to develop original information, unless he wishes to, and his burden is minimized.

The Planning Board (or other review body) then reviews the submission. If necessary, it adjusts the maximum extent of development (square feet of floor, impervious surface ratios, number of dwelling units, etc.) to be in compliance with standards, and it makes sure that performance standards are observed (septic tanks installed properly for soil condition, homes built at proper place on slopes, vegetation preserved where indicated, etc.). If all is in order, it then approves the plan.

The value of the inventory in making environmental impact assessments work on the local level are many. First, explicit base data is available free of charge to the developer (or perhaps for the cost of copying). Second, explicit review standards based on the ability of the land to assimilate development are available. These standards are determined by the community. Third, the review process is simple and judgements can be rapid and well-informed, based on preserving observed physical (and sometimes cultural) resources. In this regard, the process works to the developer's advantage, since the environmental assessment review carefully avoids becoming involved in political and social value judgements.

The costs a community can save through an environmental impact assessment process can be substantial, and can justify the time and expense necessary to create an inventory many times over. For instance, implementing higher standards for developers' handling of surface runoff in relation to site conditions--such as having scattered parking areas rather than central ones on sites with steep slopes, or retaining stormwater on-site and releasing it at controlled rates--can obviate the necessity to build major culverts, stormsewer systems, and the like, at community expense.

The fact that a natural resource inventory is necessary for the operation of the recommended local environmental review process compensates for the independence with which the planning board can operate in setting up the subdivision review process. The town has to vote the funds to conduct the inventory, and must vote or otherwise reach agreement on what natural or cultural factors are to be included in the inventory. The planning board does not have direct control over the ultimate content of the review process, and cannot force developers to take account of environmental factors to which the voters have not agreed. For instance, if the town thinks control of development in historical areas is not important, the inventory will not identify such areas and the planning board will not control them. While this may be objected to by some, the process is at least democratic.

Applicability of the Process

Much of the work done in the field of local environmental reviews has been by well-do-do suburbs on the fringes of metropolitan areas.[5] These suburbs face rapid development, are becoming aware of the hazards of unplanned growth, and have often had the resources and leadership to find innovative solutions to their problems. These solutions are broadly applicable to a wide range of communities.

Urban Areas: A review process may be designed to identify important historical and cultural areas, land that has potential for recreation and parks, areas that may be profitably converted to exclusively pedestrian use, etc. Over time, future development could be guided toward "performance" goals that make best use of an area's physical and cultural environment. Some incomplete urban renewal projects have left substantial open tracts whose future is in doubt. The aim of an environmental review process would be to go beyond the design and development stipulations commonly found in zoning ordinances to a more complete evaluation of alternative future uses of an area. Such an application of the process would, admittedly, be experimental.

Developed Suburbs: Many older suburbs exist where virtually no undeveloped land remains. However, certain areas of such suburbs often are "underdeveloped"--older structures often stand on parcels that are larger than the minimum required under current zoning. These parcels may face economic pressure for demolition and redevelopment, especially as their structures deteriorate. The redevelopment of such areas may have significant impacts on the natural systems of the local environment; as is the case with urban areas, the social, economic, and historical impact of development will also be highly important.

Developing Suburbs: Developing suburbs, which have both the most to gain and the most to lose from growth, have been the most active communities in using local environmental reviews. Since they often have large traces of undeveloped land, implementation of a review process is usually based on natural resource factors alone. Most of the work done so far concentrates almost exclusively with evaluating the impacts of new subdivisions on undeveloped areas. Because most of the base data on which such inventories are built is available at low cost from government sources, setting up an environmental review process in such areas is relatively inexpensive, technically straightforward, and administratively simple. Resource analysis can be done either through the use of contour maps as described below or through computer grid mapping.

Rural Communities: Rural communities, like suburban communities, can also conduct natural resource inventories to identify sensitive areas within their boundaries that should be protected from exploitation by inappropriate development. Unlike suburban communities, however, rural areas often have fewer financial and professional resources with which to develop a complete inventory and analysis. They also face a lower level of risk from future development simply because they will receive less of it. The solution may be to use the broader brush technique of a large-scale grid analysis, such as that developed by Bucks County, Pennsylvania, also described below. This can be done on a county level. The use of a large scale analysis may also be particularly appropriate for the planning goals that are typical of many rural areas--i.e., the preservation of large areas of land for specific single purposes, such as farming, wildlife habitat preservation or forestry.[6]

Scope of Review

Implementation of a local environmental review process can be done either through the subdivision permit system, in which case the developments affected will be exclusively residential, or through the zoning ordinance, which would permit a general site review of all projects, commercial and industrial as well as residential. There are advantages to each approach.

Implementation of the process through the subdivision permit system affects fewer properties in a town, although in developing suburban areas it is mostly residential construction that needs to be controlled. Implementation of the review is administratively easier, since the subdivision process can be amended by independent actions of the town planning board without recourse to a vote on amendments to the general zoning ordinance. Since the planning board may act on its own, this has the disadvantage of being a less "democratic" way in which to bring about change, but the clear advantages of simplicity and speed of action. And, since only subdivision permits will be affected, not zoning as a whole, the community may be more amenable to the change: in some areas, innovations in the zoning code, particularly for planning options such as PUDs, are unpopular. Environmental review of subdivisions, even when coupled with cluster zoning options and other flexible siting provisions, does not represent the same perceived threat to existing land use patterns as does the introduction of PUDs, which can mix commercial and other land uses into previously residential neighborhoods.

NATURAL RESOURCE INVENTORIES AND PERFORMANCE STANDARDS

A local environmental impact assessment need not, and probably should not, follow the outlines of a federal Environmental Impact Statement. Such extensive documents have been called for by a few communities,[7] but their preparation is probably an unreasonable expense to require of developers in the town.

There are two general ways to approach the natural resource inventory. The first is to map natural characteristics on a large scale, with only enough precision to make broadly valid community planning decisions. It is then up to developers themselves to map their sites for natural characteristics and present this data to the review board. The second approach is for all factors to be precisely mapped by the communities, relieving developers of that responsibility. Both approaches actually rely on the same primary data sources.

Inventories Based on Grid Cells

One approach, used in Bucks County, Pennsylvania, has been to map natural features on grid cells, in this case 1000' x 1000'. Average characteristics for each cell have been identified and coded into a computer. On a county-wide scale, this has provided a valuable basis for general policy decisions, but the information has little meaning for site by site review.

The virtues of the system are twofold. First, it is naturally less expensive to produce, per acre, than more detailed studies. Second, it has greater flexibility than contour mapping both for updating and for distribution, since it is computerized. Its proponents also defend it on the basis of the accuracy of the source data from which it is taken: Geological Survey and Soil Conservation Service information, the two major sources for locally produced natural resource inventories, are often only roughly accurate for specific sites, but are accurate for the comparatively course grid cells.

There are three circumstances in which grid cell inventories may be the most desirable approach to take. First, where general county-wide environmental planning is desired, detailed information is not necessary and the flexibility of computerized mappings is a major advantage. Second, if local towns are either unwilling or unable to undertake detailed inventories, the grid cell approach is better than nothing, and its data may be useful to local environmental commissions or citizens' groups in analyzing local growth. Finally, where the performance standards or environmental regulations have a single well-defined target, such as the preservation of prime agricultural land, the coarse-grained approach is fully adequate; in these situations, the lands to be protected are usually easily defined and accurately mapped, and they must be protected on a large scale basis for the program to be worthwhile.

The Bucks County study, completed in 1972, used a computer grid system to map nine categories of natural development limitations:[8]

- prime agricultural land
- forests
- slope
- wetlands
- lakes and ponds
- floodplains
- scenic areas
- seasonal high water tables
- sewerage limitations.

An example map is shown on the following page (Figure 16). A composite natural resource protection map was also prepared (Figure 17), describing in graphic terms the development policy desired for the county on the basis of an interpretation of the several base maps. The relatively small number of mapping categories, and the coarse-grained approach to mapping it, reduced costs and was appropriate for its prime goal--the protection of prime agricultural lands in the County.

While this approach does not allow a direct evaluation of each development site, communities can enlarge their own section of the mapping and use it for general planning purposes. This approach is most useful where allocation of growth within a large area is the planning objective, rather than site by site review of development impacts. As Figure 18, an enlarged section of the grid, shows, detail is not adequate on the site level to permit meaningful specific reviews of developers' plans.

Contour-Mapped Inventories

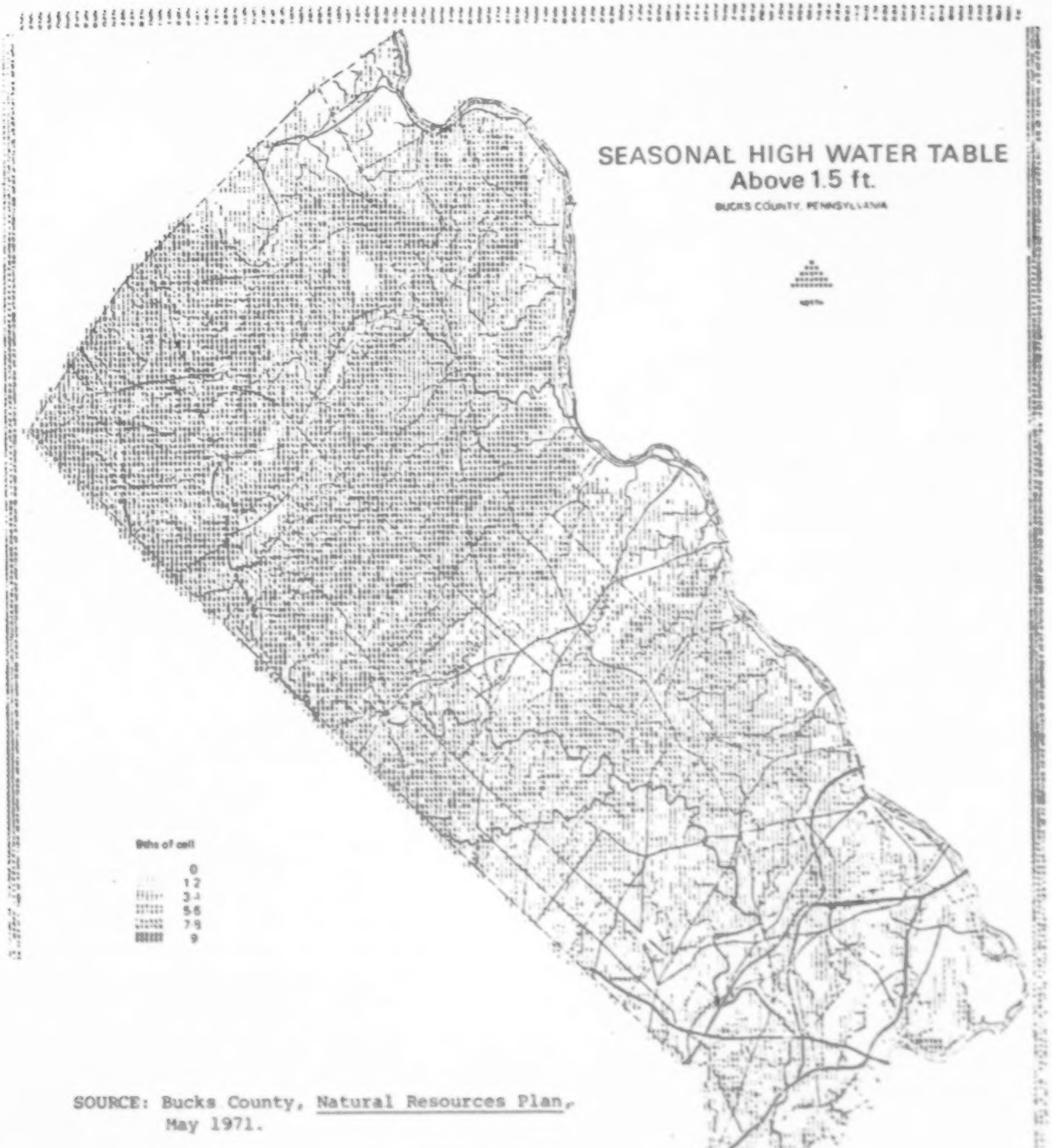
In a contour-mapped inventory, all environmental factors of concern are directly represented on maps of the town or county. Base information, drawing heavily on data from the U.S.G.S., the SCS, Corps of Engineers and the like, are used in conjunction with field checks and local expertise to produce a document that describes environmental conditions on every site of concern in a local jurisdiction (already developed areas might not be mapped). The accuracy of such mappings is, of course, open to constant review--both by the town and by developers or landowners.

The prime benefit of a contour mapped inventory is that, despite its inevitable inaccuracies, it can legally be regarded as presumptively valid. Since it is based on the best available sources--in most cases, federal documents--it is up to developers to demonstrate to the town's, and presumably to the court's, satisfaction that the restrictions it may imply for a particular plot are based on inaccurate data. Once a contour mapped natural resource inventory is completed by a town, the burden of proof is on the developer to show that his property is being excessively restricted.

Contour mapped inventories are appropriate for site reviews of subdivisions (or all new development projects) in most suburban areas, and in rural areas experiencing residential growth.

Figure 16

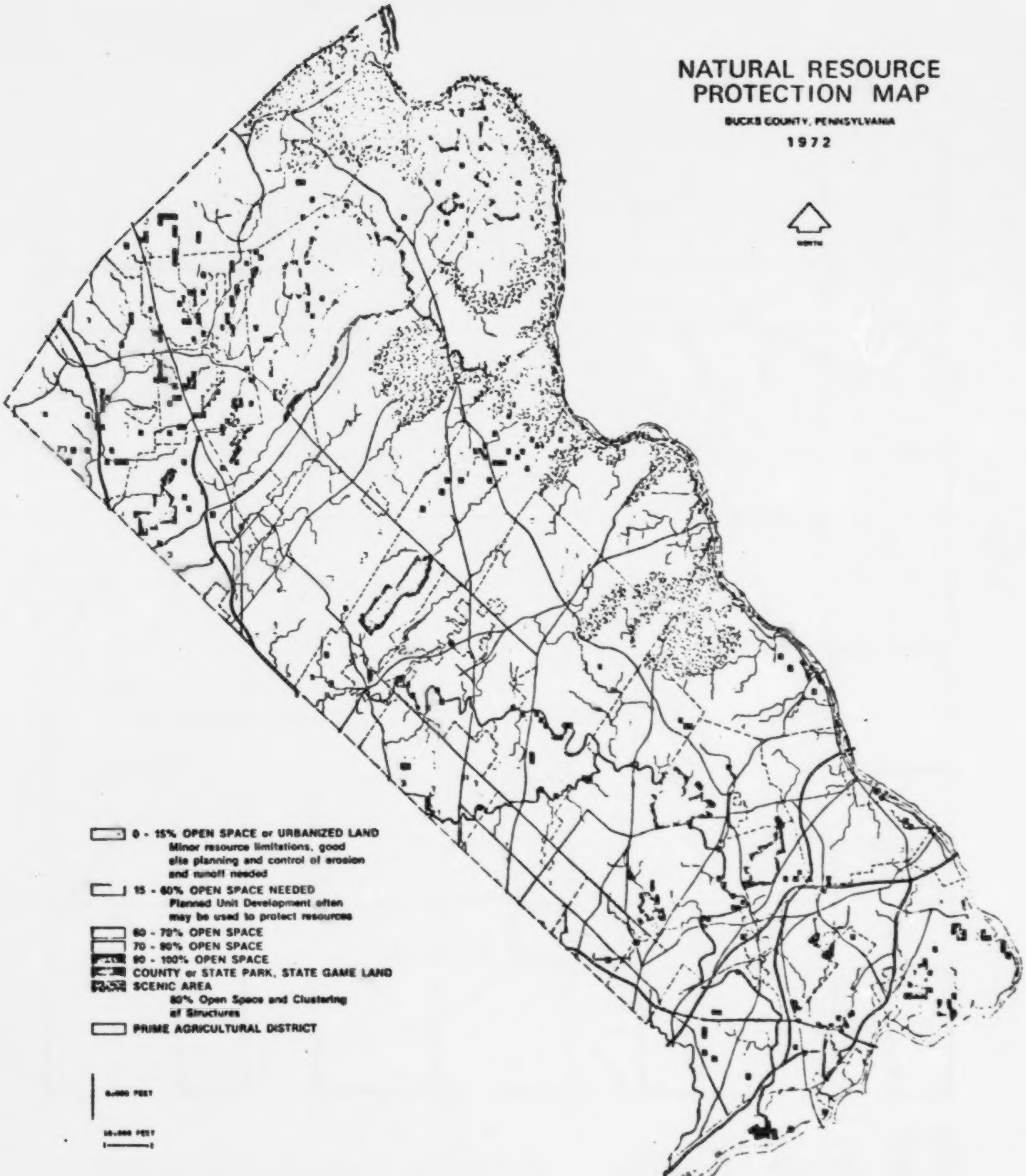
Computer Map of Bucks County, Pennsylvania


SEASONAL HIGH WATER TABLE
Above 1.5 ft.
BUCKS COUNTY, PENNSYLVANIA
NORTH
9ths of cell
0
1 2
3 4
5 6
7 8
9

SOURCE: Bucks County, Natural Resources Plan, May 1971.

Figure 17

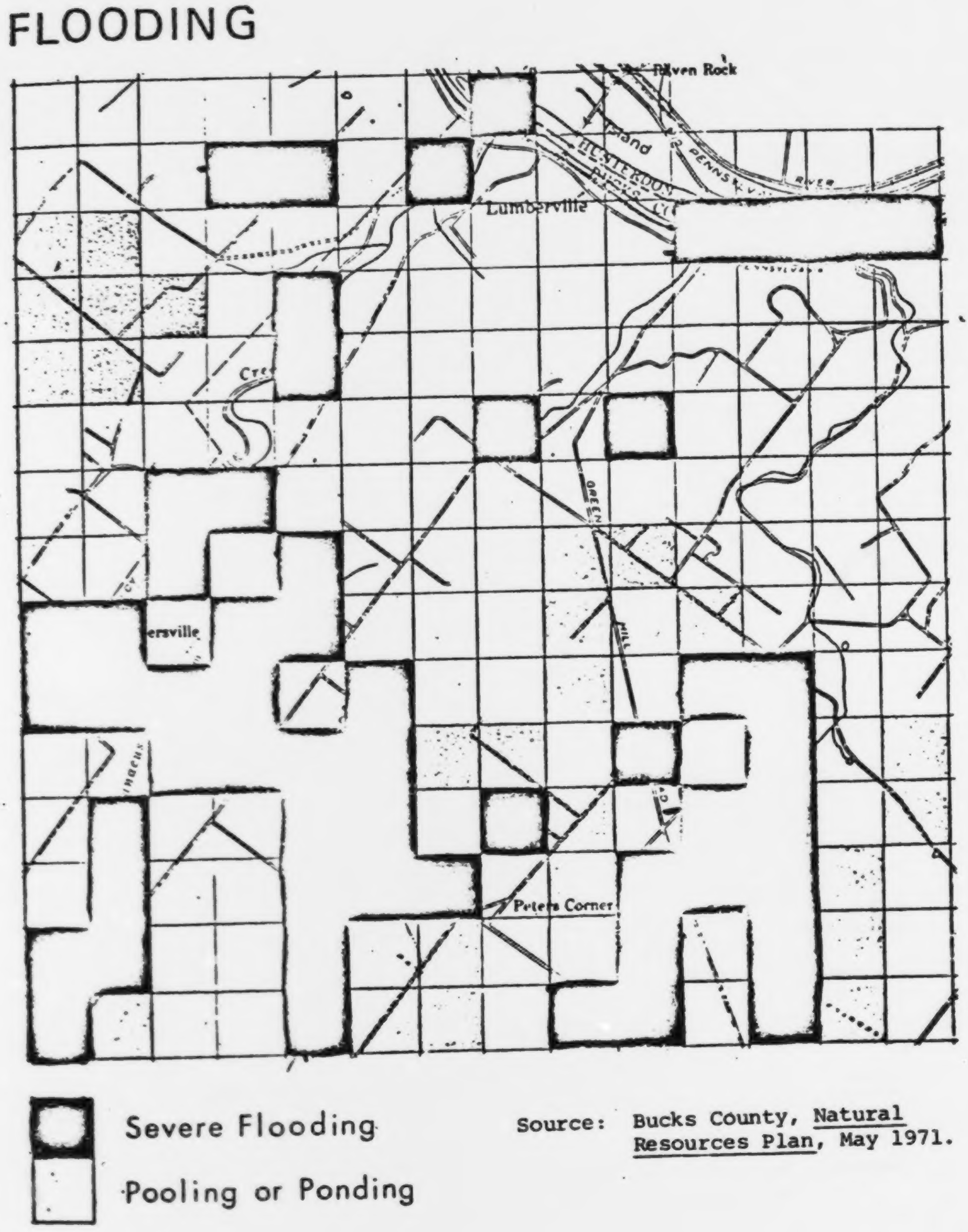
Composite Computer Map of Bucks County, Pennsylvania


NATURAL RESOURCE PROTECTION MAP
BUCKS COUNTY, PENNSYLVANIA
1972
NORTH
0 - 15% OPEN SPACE or URBANIZED LAND
Minor resource limitations, good site planning and control of erosion and runoff needed
15 - 60% OPEN SPACE NEEDED
Planned Unit Development often may be used to protect resources
60 - 70% OPEN SPACE
70 - 90% OPEN SPACE
90 - 100% OPEN SPACE
COUNTY or STATE PARK, STATE GAME LAND
SCENIC AREA
80% Open Space and Clustering of Structures
PRIME AGRICULTURAL DISTRICT

Source: Bucks County, Natural Resources Plan, May 1971.

Figure 18

Enlarged Computer Map, Showing Loss of Usefulness on Local Level Site Reviews


FLOODING
Raven Rock
HUNTERDON
BUCKS CO
RIVER
Lumberville
ersville
Peters Corner
Severe Flooding
Pooling or Ponding

Source: Bucks County, Natural Resources Plan, May 1971.

They can be used as a basis for revision of zoning maps where there are strong inconsistencies between the suitability of land for development and the type of development allowed under the zoning.[9] They can be used as the basis for overlay maps of sensitive lands, if that is the mechanism by which such lands are to be protected.[10]

The Department of Landscape Architecture and Regional Planning at the University of Pennsylvania undertook a seven year study of one town in Pennsylvania (by coincidence it also is in Bucks County); assembling nine primary coutour maps:[11]

- geology
- slope
- surface hydrology
- aquifers
- soils
- runoff management units
- potential soil loss
- land use
- prominent physiographic features.

Geology: The geologic map showed lithographic and structural features, the names of rock formations, and the rock types. Structural features and rock types are important in determining suitabilities for local bearing capacity, and for mineral and water resource values. The map was colored in such a way as to show the most unpredictable and unstable formations in high contrast to the stable crystalline formations. The map was adapted from a previous Geologic Map of Bucks County.

Slope: This map was developed from commonly available U.S.G.S. topographic maps (scale 1:24,000, 20' contours). The slope grades were divided into five ranges:

- 0-3%
- 3-8%
- 8-15%
- 15-25%
- 25%+.

These ranges are consistent with Soil Conservation Service soil types, and are generally used in determining suitabilities for roads, large structures, areas of pavement, and drainage systems. The steepest slopes were indicates in the darkest colors.

Surface Hydrology: This map was a composite from the same U.S.G.S. 1:24,000 map, the Bucks County Interim Soil Survey Report's delineation of alluvial soils, and U.S. Army Corps of Engineers' floodplain data. First order streams (the source areas of streams into which no tributary streams flow) were highlighted, since they are sensitive to degradation because of their low and sometimes intermittent flows, and often contained saturated soils or marshes. Flood prone areas were identified because of the obvious hazard present to life and property.[12]

Aquifers: The water bearing potential of geologic formations in the town were marked, with the darkest color given to areas of the greatest potential water yield. These data are important for determining the availability of groundwater for wells, the potential for groundwater pollution, and the need to protect areas of groundwater recharge. The source was a report entitled, "Ground Water Resources for Bucks County."

Soils: Using the Bucks County Interim Soil Survey Report, a complex map was prepared showing soil composition, drainage (range of soil permeability), and depth to seasonal high water table. Subsoil textures were shown on an overlay. The wettest, most poorly drained soils showed up as darkest, with well-drained soils rendered light. Permeability and drainage are important for planning roads and utility systems, buildings with basements, and agriculture. Soil texture influences stability, bearing capacity, erosion potential, and agricultural workability.

Runoff Management Units: This stormwater runoff map was a composite of soils and land use maps, and was based on a Soil Conservation Service formula contained in the SCS, National Engineering Handbook. Runoff is a function of rainfall intensity (which varies by region), land use, and soil properties. The map shows five classes of infiltration time, and an accompanying table shows changes in this time according to development densities. A more elaborate and detailed table is shown on the following page, showing for a specified storm how much additional runoff is generated by each soil class as land use becomes more intense (see Table 43).

Potential Soil Loss: Susceptibility of land to erosion can be calculated from another SCS formula, and it was mapped in ranges of tons/acre/year. Ranges were:

- 0 tons/acre/year
- <25
- <50
- <100
- <250
- <500
- >500.

Land Use: This was a general map, and included vegetation types. Most of the information was interpreted from aerial photographs. Undeveloped land was categorized as:

- cropland
- pasture
- orchard
- successional meadow/forest
- forest/woodlot.

These categories are sufficient for land suitability analysis, except where forests are of economic value or where rare species or wildlife habitats exist. Developed lands can be grouped into:

Table 43

RUNOFF MANAGEMENT CHART

EXISTING CONDITION

Excess Runoff in inches produced during the most intense hour of 10 year recurrent 24 hour rainfall by a prospective land use; and the percentage of site area required for withholding it, to allow its infilteration locally within three hours

			PLAYFIELD ETC.					2 ACRE RESIDENTIAL					1 ACRE RESIDENTIAL					½ ACRE RESIDENTIAL					¼ ACRE RESIDENTIAL					CROPLAND					INTENSIVE URBAN				
	COVER TYPE	SOIL GROUP	RUNOFF	INFILTERATION CLASS				RUNOFF	INFILTERATION CLASS				RUNOFF	INFILTERATION CLASS				RUNOFF	INFILTERATION CLASS				RUNOFF	INFILTERATION CLASS				RUNOFF	INFILTERATION CLASS				RUNOFF	INFILTERATION CLASS			
				I	II	III	IV		I	II	III	IV		I	II	III	IV		I	II	III	IV		I	II	III	IV		I	II	III	IV		I	II	III	IV
1 thru 4	All Forests and Upland Successional Meadow	A	0	0	0			0	0	0			0	0	0			0·02	0	0			0·12	1	2			0·20	1	3			2·00	10	33		
		B	0·02	0	0	1		0·12	1	2	6		0·16	1	3	8		0·20	1	3	10		0·40	2	7	21		0·44	2	7	23		1·30	10	32	100	
		C	0·04		1	2	7	0·16		3	8	27	0·24		4	13	40	0·28		5	15	47	0·43		7	23	72	0·43		7	23	72	1·58		26	83	263
		D	0·04			2		0·03			5		0·24			13		0·29			15		0·47			25		0·64			107		1·44			76	
5	Lawns, Parks etc.	A						0	0	0			0	0	0			0·02	0	0			0·12	0	2			0·20	1	3			2·00	10	33		
		B						0·10	1	2	5		0·14	1	2	7		0·18	1	3	9		0·38	2	6	20		0·42	2	7	22		1·89	10	31	100	
		C						0·12		2	6	20	0·20		3	10	33	0·24		4	13	40	0·39		6	21	65	0·39		6	21	65	1·54		26	81	257
		D						0·05			3		0·20			10		0·25			13		0·43			23		0·60			100		1·40			74	
6	2 Acre Residential	A											0	0	0			0·02	0	8			0·12	1	2			0·20	1	3			2·00	10	33		
		B											0·04	0	1	2		0·16	1	3	8		0·28	1	5	15		0·32	2	5	17		1·78	9	30	94	
		C											0·08		1	4	13	0·12		2	6	20	0·27		5	14	45	0·27		5	14	45	1·42		24	75	237
		D											0·15			8		0·20			10		0·38			63		0·55			92		1·35			71	
7	Pasture	A											0	0	0			0·02	0	0			0·12	1	2			0·20	1	3			2·00	10	33		
		B											0·08	0	1	4		0·12	1	2	6		0·22	1	4	12		0·26	2	4	14		1·72	9	29	86	
		C											0		0	0	0	0·04		1	2	7	0·19		3	10	32	0·19		3	10	32	1·31		23	71	223
		D											0			0		0·05			3		0·23			12		0·43			21		1·20			63	
8	1 Acre Residential	A																0·02	0	0			0·12	0	2			0·20	1	3			2·00	10	33		
		B																0·04	0	1	2		0·24	1	4	13		0·28	2	5	15		1·74	9	29	92	
		C																0·04		1	2	7	0·19		3	10	32	0·19		3	10	32	1·34		22	71	223
		D																0·05			3		0·23			12		0·40			21		1·20			63	
9	½ Acre Residential	A																					0·10	1	2			0·18	1	3			1·99	10	33		
		B																					0·20	1	3	11		0·24	1	4	13		1·70	9	26	90	
		C																					0·15		3	8	25	0·15		3	8	25	1·30		22	69	217
		D																					0·28			15		0·35			58		1·13			60	
10	Farmstead	A																					0·03	0	1			0·11	1	2			1·91	10	32		
		B																					0·04	0	1	2		0·08	0	1	4		1·54	8	26	81	
		C																					0·05		1	3	8	0·05		1	3	8	1·20		20	63	200
		D																					0·09			5		0·26			14		1·06			56	
11	¼ Acre Residential	A																										0·06	0	1			1·88	10	31		
		B																										0·04	0	1	2		1·50	8	25	79	
		C																										0		0	0	0	1·15		19	61	192
		D																										0·19			10		0·97			51	
12	Cropland	A																															1·80	10	30		
		B																															1·45	8	24	77	
		C																															1·15		19	61	192
		D																															0·80			42	

Light shading indicates absence of any soils with such Hydrologic Soil Group/Infilteration Class combination.
Dark shading indicates no increase in runoff by alteration of existing condition by prospective land use.

SOURCE: Juneja, et. al.

- Urban--extensive open spaces (institutional/ recreational areas)
- Urban--without extensive open space.

Other land use categories were not felt necessary for developed land, as they had minimum significance for natural resource analysis.

Prominent Physiographic Features: This was a visual interpretation of scenic values in the township done by a landscape architect on the basis of a visual survey of his own, together with interpretations of the topographic and land use maps. Taking views, vegetation, development, and other factors into consideration, the map showed those areas where the existing development was more compatible with physiographic features, and where, therefore, the greatest scenic value had to be preserved. (The more brilliant colors indicated greater scenic value.).

The resulting natural resource maps then served as a base for two composite maps, showing development constraints and development opportunities. Finally, a synthetic map was prepared from these two. The rules used to interpret the data were complicated, but in general the process used a series of overriding rules: some categories of land--such as flood hazard areas, first order streams, and quarries (typical of the area)--were considered as constraining development no matter what opportunities were available; other less restricted categories were traded off against development opportunities in a sort of sliding scale, ending up with recommendations for development where constraints were minimal and opportunities great. Opportunities include desirability of location (scenic values), low slopes, adequate depth to bedrock and seasonal high water table, and some minor features such as frost-heave and shrink-well potential, stability and drainage.

Comments:

While the study described above was done at a university, much of the work is straightforward enough to use relatively unskilled volunteer labor, provided there is qualified professional oversight (which, of course, could also be volunteer). For instance, mapping of slopes and soils, if done from well documented and well presented source material, is not difficult. Some maps, such as those requiring the use of interpretation formula, must best be left to professionals. Synthetic maps showing general suitability for different kinds of development may be done with a combination of professional and lay staff, according to the complexity of the process.

For comparison, two other sets of natural factors that might be included in natural resource inventories are listed on the following pages. The first list was published by the Bedminster Township Environmental Commission and the Upper Raritan Watershed Association, and includes many more social and land use factors than the project described above. The other was compiled by the Center for Ecological Research in Planning and Design at the University of Pennsylvania, and the Department of Environmental Resources, Commonwealth of Pennsylvania. It presents the level of detail reported in the study of Medford Township, New Jersey, by the Center for Ecological Research (Tables 44 and 45).

Table 44

Guidelines for Municipal Resource Inventory

1. Maps and Diagrams Portraying data for all pertinent parameters including but not limited to:
    - A. Bedrock geology
    - B. Soils
    - C. Topography
    - D. Vegetation
    - E. Water resources
    - F. Flood plains and wetlands (including state delineation)
    - G. Surface water quality
    - H. Existing land use including roads, public and private open space
    - I. Zoning
    - J. Historic sites
    - K. Sight lines
    - L. Natural features
    - M. Drainage and runoff
    - N. Erodibility
    - O. Public and private utilities
    - P. Depth to bedrock
    - Q. Permeability
    - R. Climate--graphs
        - Mean max. temp. °F
        - Mean min. temp. °F
        - Max rain density/hr.=inches
        - Mean annual precipitation
        - Average annual snow fall
        - Average annual fog days
    - S. Tax map
    - T. Wildlife habitat

II. Interpretative maps for all pertinent parameters including but not limited to:
- A. Soils limitations for:
    1. Septic systems
    2. Road building
    3. Buildings
- B. Adequacy of transportation facilities
- C. Assimilative capacity of streams

(continued on following page)

Table 44 (continued)

D. Critical Areas
    1. Steep slopes
    2. High water table
    3. Flood plains
    4. Shallow bedrock
    5. Mature woodlands
    6. Historic archaelogical
    7. Unique natural features

E. Agricultural capability
F. Estimate of highest and best use of land

III. Maps and diagrams depicting the municipality in the region, including but not limited to:

A. Geographic location
B. Transportation systems
    1. Roads, rails, etc.

C. Regional zoning
D. Regional planning
E. Existing regional land use
F. Utility systems
G. Water Resources
H. Sewage disposal systems

IV. Interpretation

A. Analysis of resource capabilities vs. existing resource use

V. Bibliography of references and sources.

SOURCE: Ashmun and Larson, Municipal Land Use Decisions: The Tools and Methods, Bedminster Township Environmental Commssion and the Upper Raritan Watershed Association.

Table 45

Natural Factors

A. CLIMATE

- Temperature
- Precipitation
- Wind
- Climatic Hazard
- Air Quality

B. GEOLOGY

- Calcareous Rocks
- Other Rocks
- Economic Minerals
- Unique Geologic Features
- Seismic Activity Areas
- Unstable Formations and Features

C. PHYSIOGRAPHY

- Slope
- Inversion Zones
- Poor Ventilation Areas
- Fog and Frost Areas
- Prominent Physiographic Features

D. HYDROLOGY

- Hydrography
- Surface Water Quantity
- Surface Water Quality
- Floodplains
- Wetlands
- Groundwater Quantity
- Groundwater Quality
- Aquifer Recharge Areas
- Groundwater Recharge Areas
- Areas with High Water Table

W. SOILS

- Drainage
- Texture
- Nutrient Exchange Capacity
- Potential Biologic Productivity
- Bearing Capacity
- Permeability

(continued on following page)

Table 45 (continued)

Erodibility
Shrink-Swell Potential
Thermal Conductivity
Extractable Soils
Distance to Bedrock

F. VEGETATION

Forest
Shrub
Grassland
Marshes and Bogs
Aquatic
Rare Vegetation Communities
Vegetation Sensitive to Disturbance
Fire-Prone Vegetation
Hazardous Vegetation
Commercially Valuable Vegetation
Change in Vegetation types due to Ecological Succession

G. WILDLIFE

Terrestrial Habitats
Aquatic Habitats
Rare Species
Species Sensitive to Disturbance
Beneficial Species
Hazardous Species
Nuisance Species
Game Species
Commercially Valuable Species
Movement Corridors

Inventory Analysis and Development of Performance Standards

Once the inventory has been completed, it is necessary to develop standards for development activities within the mapped areas. These must be based first on an understanding of how various human activities affect natural systems, and second on how much disruption to these syspems should be tolerated.

The Center for Ecological Research at the University of Pennsylvania has developed a series of matrices to demonstrate the reltionships between physical development activities and natural resources (Matrices I-V are Figures 19 through 23, respectively.) The first three trace the direct relationships between land use and natural environmental factors (no secondary effects or interactions are considered); the fourth matrix relates natural factors to human values, and the fifth backsteps to relate land use categories to values. It is worth examining these steps briefly to demonstrate their usefulness in rationalizing the use of environmental information in reaching specific decisions.

Matrix I presents (aggregated) classes of land uses in terms of the development activities necessary to create them. For instance, in a specific community, low density residential development is seen to involve (solid dot): siting, construction activities, paving and building, on-site water supply and waste disposal, and solid waste disposal. In certain circumstances, it may also involve (empty dot) clearing of vegetation, excavation, filling, site drainage, irrigation, harvesting, and air-borne waste disposal.

Matrix II shows the relationships between the development activities of Matrix I and the processes through which they affect natural factors in the study area. For instance, supplying water on-site (digging a well) may induce land subsidence and may alter the storage and movement of groundwater; providing site drainage will always alter evapotranspiration characteristics of the site and will always alter the storage and movement of groundwater.

Matrix III relates the processes discussed in Matrix II to the natural factors they affect. For instance, subsidence (e.g., caused by on-site water supply in low density residential development) is seen always to affect soils by altering their bearing capacity, permeability, and thermal conductivity. The arrow symbol used on this matrix refers to the following Matrix IV, and states in this case that while subsidence will not alter the shrink-swell potential of the soil, if activities associated with development cause soil subsidence the shrink-swell potential will become a problem to human activities on the site.

Matrix IV discusses a wide range of similar interactions between human values and natural factors. While many of the relationships are readily evident (e.g.,seismic activity areas are clearly hazardous to life and property), the process of evaluating the interrelationships will keep track of interrelationships often dismissed in planning decisions, such as the value of unstable geologic formations for education (arguing for their inclusions in public parks). A solid dot in this case means that a specific decision must be made

Figure 19

Matrix I

KEY

● Direct Relationship

○ Conditional Relationship

I

DEVELOPMENT ACTIVITIES

LAND USES	Siting	Clearing of Vegetation	Excavation	Filling	Site Drainage	Construction Activities	Paving and Building	Water Supply: on-site	Water Supply: off-site	Working the Soil	Planting	Irrigating	Harvesting	Applying Fertilizer, Pesticides, etc.	Liquid-Borne Waste Disposal: on-site	Liquid-Borne Waste Disposal: off-site	Solid Waste Disposal	Air-Borne Waste Disposal	Extraction
Parks, Playgrounds, etc.	●	○	○	○	○	○	○	○	○		○	○	○	○	○	○	●	○	
Agriculture	●	●			○			○		●	●	○	●	●	●		●	○	
Water Impoundments	●	●	●	●	○	●					○								
Utility Corridors	●	●	●		○	●					○			●					
Transportation Corridors	●	●	●	●	●	●	●				●			●			○	●	
Institutional	●	●	●	○	○	●	●	○	○		○	○		○	○	○	●	○	
Low Density Residential	●	○	○	○	○	●	●	●			●	○		○	●		●	○	
Medium Density Residential	●	●	○	○	○	●	●		●		○	○		○	○	○	●	○	
High Density Residential	●	●	●	●	○	●	●		●		○	○		○		●	●	○	
Commercial	●	●	●	○	○	●	●	○	○		○	○		○	○	○	●	○	
Industrial	●	●	●	●	○	●	●	○	○						○	○	●	●	
Land Fill	●	●	○	●	○	●	○							○	●	○	●	●	
Mining	●	○	●	○	○	●	○	○	○						●	○	●		●

Figure 20

Matrix II

KEY

● Direct Relationship

○ Conditional Relationship

II

DEVELOPMENT ACTIVITIES / PROCESSES THROUGH WHICH DEVELOPMENT ACTIVITIES AFFECT NATURAL FACTORS	Alteration of Surface Reflectance	Alteration of Evapotranspiration	Alteration of Exposure to Wind	Alteration of Air Quality	Occupation of Space	Depletion by Export	Addition by Import	Compaction	Subsidence	Surface Erosion	Mass Wasting	Modification of Balance between Infiltration and Overland Flow	Alteration of Channel Deposition and Erosion	Alteration of Storage and Movement of Groundwater	Alteration of Water Quality	Alteration of Numbers of Species	Alteration of Numbers of Individuals	Modification of Life Support Systems	Alteration of Landscape Quality	Pre-emption of
Siting			○		●							○						○	●	●
Clearing of Vegetation	●	●	○					○		●	○	●			○	○	●	●	●	
Excavation	●	●	○	○	●	●			○	●	○		○	○		○	○	○	●	
Filling	●	●	○		●		●	●	○		○	○	○			○	○	○	●	
Site Drainage	●	●						○	○	○		●	○	●		○	●	●	●	
Construction Activities								●		●	○	○	○			○	○	○	●	
Paving and Building	●	●	○		●							●	○	○	○			○		○
Water Supply: on-site									○					○						
Water Supply: off-site					○								○	○	○			○	●	
Working the Soil	●							●		●		●					○	●		
Planting	●	●								○		●	○	○		○	●	○	●	
Irrigating		●								○	○	●	○		●		○	●		
Harvesting												●				○	●	○		
Applying Fertilizer, Pesticides, etc.				○											●	●	●	●		○
Liquid-Borne Waste Disposal: on-site					●						○	○			○		○	○		
Liquid-Borne Waste Disposal: off-site					●								○		●		○	○	○	
Solid Waste Disposal					●		●	○				○			●	○	○	●	○	
Air-Borne Waste Disposal				●												○	○	○	○	○
Extraction				○	●	●			○	○		○		○					○	○

Figure 21

Matrix III

KEY
● Direct Relationship
○ Conditional Relationship
← No Relationship but Value Affected

III

PROCESSES THROUGH WHICH DEVELOPMENT ACTIVITIES AFFECT NATURAL FACTORS NATURAL FACTORS	Alteration of Surface Reflectance	Alteration of Evapotranspiration	Alteration of Exposure to Wind	Alteration of Air Quality	Occupation of Space	Depletion by Export	Addition by Import	Compaction	Subsidence	Surface Erosion	Mass Wasting	Modification of Balance between Infiltration and Overland Flow	Alteration of Channel Deposition and Erosion	Alteration of Storage and Movement of Groundwater	Alteration of Water Quality	Alteration of Numbers of Species	Alteration of Numbers of Individuals	Modification of Life Support Systems	Alteration of Landscape Quality	Pre-emption of Development Capacity
CLIMATE																				
Temperature	●	○	○														○			
Precipitation			○																	
Wind	○		←		←												←			
Climatic Hazard					←															
Air Quality				●																
GEOLOGY																				
Calcareous Rocks						○			←				←	←	←					
Other Rocks						○														
Economic Minerals					←	●														←
Unique Geologic Features					←	○			○	←	←									←
Seismic Activity Areas					←									←						
Unstable Formations and Features					←	○	○	○	←	←	←	←		←			←			
PHYSIOGRAPHY																				
Slope					←					←	←									
Inversion Zones	○	○	○	←	←															
Poor Ventilation Areas			○	←	←															
Fog and Frost Areas	○	○	●		←							○								
Prominent Physiographic Features					○	○				○	○		○	○					●	←
HYDROLOGY																				
Hydrography						○	○	○	○	○	○	○	●	○					○	←
Surface Water Quantity												●		○						←
Surface Water Quality			○							●	○		●		●	○	○	○		←
Floodplains					←		○			●		●	●							
Wetlands		○	○		←	←	○	●		●		○	●	○				○		←
Groundwater Quantity								○				●	○	●						←
Groundwater Quality															●		○	○		←
Aquifer Recharge Areas					←		○	←		←		←		●	←					
Groundwater Discharge Areas						←	←	●		←	←		○	●						←

(continued on following page)

Figure 21 (continued)

KEY
● Direct Relationship
○ Conditional Relationship
← No Relationship but Value Affected

III

PROCESSES THROUGH WHICH DEVELOPMENT ACTIVITIES AFFECT NATURAL FACTORS

NATURAL FACTORS	Alteration of Surface Reflectance	Alteration of Evapotranspiration	Alteration of Exposure to Wind	Alteration of Air Quality	Occupation of Space	Depletion by Export	Addition by Import	Compaction	Subsidence	Surface Erosion	Mass Wasting	Modification of Balance between Infiltration and Overland Flow	Alteration of Channel Deposition and Erosion	Alteration of Storage and Movement of Groundwater	Alteration of Water Quality	Alteration of Numbers of Species	Alteration of Numbers of Individuals	Modification of Life Support Systems	Alteration of Landscape Quality	Pre-emption of Development Capacity
SOILS																				
Drainage					←							○		○						
Texture					←	●	●					○	○	●						
Nutrient Exchange Capacity				○	←															←
Potential Biologic Productiv[illegible]					←	←			←	←										←
Bearing Capacity					←			●												←
Permeability					←			●												
Erodibility			←		←					←		←		←			←			
Shrink-Swell Potential					←			←				←		←						
Thermal Conductivity								●												
Extractable Soils					←	●				←	←									←
VEGETATION																				
Forest			○	○	●						○	○		○	○	○	○	●	○	←
Shrub				○	●							○		○	○	○	○	●	○	←
Grassland				○	●							○		○	○	○	○	●	○	←
Marshes and Bogs				○	●							○	○	○	○	○	○	●	○	←
Aquatic													○		●	○	○	●	○	←
Rare Vegetation Communities			○	○	←						○	○	○	○	○	○	○	●		←
Vegetation Sensitive to Disturbance		○	○	○	●			○		○		○	○	○	○			●		
Fire-Prone Vegetation			←	○	←							○		○	○	○	○	●		
Hazardous Vegetation				○	←							○		○	○	○	○	●		
Commercially Valuable Vegetation			○	○	←							○		○	○	○	○	●		←
WILDLIFE																				
Terrestrial Habitats				○	←	○				←		○		○	○			●	○	←
Aquatic Habitats			○		←								○		●			●	○	←
Rare Species				○											○	●	●	●		←
Species Sensitive to Disturbance			○	○	●					○		○	○	○	○	○	○	●		
Beneficial Species				○											○	←	←	●		←
Hazardous Species				○	←							○	○	○	○	←	←	●		
Nuisance Species				○	←							○	○	○	○	←	←	●		
Game Species				○								○	○	○	○	←		●		←
Commercially Valuable Species				○								○	○	○	○	←	←	●		←
Movement Corridors				○											○				○	←

Figure 22

Matrix IV

KEY

● Direct Relationship

○ Conditional Relationship

IV

Reproduced from best available copy.

VALUES	SOCIAL							INDIVIDUAL				
	Hazardous			Valuable				Desireable				
NATURAL FACTORS	To Life	To Property	To Continued Health	Unique-Scarce Natural	Unique-Scarce Cultural	Unique-Scarce Economic	Unique-Scarce Aesthetic	For Habitation	For Recreation	For Education	For Health	For Maintenance of Property Value
CLIMATE												
Temperature			○					●	●		●	
Precipitation			○					●	●		●	
Wind								●	●		●	
Climatic Hazard	●	●	●							○		
Air Quality	○	○	●					●	●		●	●
GEOLOGY												
Calcareous Rocks	○	○		○		○			○	○		
Other Rocks				○		○				○		
Economic Minerals			○			●				●		○
Unique Geologic Features				●	○	○	○		●	●		●
Seismic Activity Areas	●	●	●	○						○		
Unstable Formations and Features	○	●	○	○						○		
PHYSIOGRAPHY												
Slope		○						○	●			
Inversion Zones	○	○	●									
Poor Ventilation Areas	○	○	●									
Fog and Front Areas	●	●	●									
Prominent Physiographic Features				○	○	○	○	●	●	○		●
HYDROLOGY												
Hydrography				○	○	○	○	●	●	○	●	●
Surface Water Quantity	○	○				●		○	○		○	○
Surface Water Quality	○	○	●	○		●		●	●	○	●	●
Floodplains	●	●			○	○	○		○			○
Wetlands				●	○	○	○		●	○	○	○
Groundwater Quantity						●		●			○	●
Groundwater Quality	○		●		○	●		●			●	●
Aquifer Recharge Areas				○		○						○
Groundwater Discharge Areas		○	○	●		○	○	○	●	○		○

(continued on the following page)

Figure 22 (continued)

KEY
● Direct Relationship
○ Conditional Relationship

IV

NATURAL FACTORS	VALUES											
	SOCIAL							INDIVIDUAL				
	Hazardous			Valuable				Desirable				
	To Life	To Property	To Continued Health	Unique-Scarce Natural	Unique-Scarce Cultural	Unique-Scarce Economic	Unique-Scarce Aesthetic	For Habitation	For Recreation	For Education	For Health	For Maintenance of Property Value
SOILS												
Drainage		○	○					●	●		●	●
Texture		○	○			○		●	○		●	●
Nutrient Exchange Capacity			●			●		●			●	●
Potential Biological Productivity						●		●				●
Bearing Capacity		○				○		●	●			●
Permeability						○		●	●		○	●
Erodibility		○		○		○		●	●			●
Shrink-Swell Potential		●				○		●	●			●
Thermal Conductivity			○			○		●	●		●	○
Extractable Soils				○		●				●		●
VEGETATION												
Forest				○	○	○	○	●	●	○		●
Shrub						○	○		●	○		
Grassland				○	○	●	○		●	○		
Marshes and Bogs				○	○	○	○		●	○		○
Aquatic				○	○	○	○		●	○	○	○
Rare Vegetation Communities				●	○	○	○	○	●	●		●
Vegetation Sensitive to Disturbance				○			○	○	○	●		○
Fire-Prone Vegetation	●	●		○			○		○	●		
Commercially Valuable Vegetation				○	○	●	○					○
WILDLIFE												
Terrestrial Habitats				○	○	○		○	●	●		○
Aquatic Habitats				○	○	○			○	●		○
Rare Species	○			●	○	○	○	○	●	●		●
Species Sensitive to Disturbance				○			○	○	○	●		○
Beneficial Species				○	○	●	○	○	○	●	●	●
Hazardous Species	●	●	●	○	○	○	○		○	○		
Nuisance Species		○	○	○		○	○		○	○		
Game Species				○	○	○	○	○	●	○		○
Commercially Valuable Species				○	○	●	○	○	●	○		○
Movement Corridors	○	○	○	●	○	○	○	○	●	○		○

Figure 23

Matrix V

KEY

- ● Critical Relationship
- ○ Possible Relationship
- ↑ Land Use Must Be Regulated to Maintain Value

V

VALUES: OPPORTUNITIES AND CONSTRAINTS	SOCIAL							INDIVIDUAL				
	Hazardous			Valuable				Desirable				
LAND USES	To Life	To Property	To Continued Health	Unique-Scarce Natural	Unique-Scarce Cultural	Unique-Scarce Economic	Unique-Scarce Aesthetic	For Habitation	For Recreation	For Education	For Health	For Maintenance of Property Value
Parks, Playgrounds, etc.	○	○	○	●	●		●	○	●	●	○	○
Agriculture*	○	○	○	○	○	○	○	○	○	○	○	○
Water Impoundments	○	○	○	○	○	○	○	○	●	○	●	○
Utility Corridors		○	●	↑	↑	●	↑	○	↑	○	↑	○
Transportation Corridors	●	●	○	○	○	●	○	○	○	○	↑	○
Institutional	●	●	●	○	●	○	○	○	○	●	○	○
Low Density Residential	●	●	●	↑	↑	○	↑	●	○	○	●	○
Medium Density Residential	●	●	●	↑	↑	○	↑	●	○	○	●	○
High Density Residential	●	●	●	↑	↑	○	↑	●	○	○	●	○
Commercial	●	●	●	↑	↑	○	↑	○	○	○	○	○
Industrial	●	●	●	↑	↑	○	↑	○	↑	○	○	○
Land Fill		○	●	↑	↑	↑	↑	↑	↑	○	↑	○
Mining	○	○	○	↑	↑	●	↑	↑	○	○	○	○

about an interaction in making a land use decision (e.g., "is the land too erodable to be used for recreation?", or "will development wipe out commercially valuable wildlife species?"). An open dot shows that the relationships are not critical, but are present.

Finally, Matrix V summarizes the conclusions to be reached, relating land uses to opportunities and constraints founded on social and individual values. A solid dot indicates that decisions concerning that land use will be made with respect to that value, e.g., low density residential development will be conducted to take account of any possible hazards to life, property, and continued health, as well as to the desirability of that development for individual criteria for habitations. Performance criteria to protect against such hazards can be based on scientific evaluations. An open dot represents conditional constraints, e.g., low density residential development decisions may have to consider alternative uses of the land for recreation, education or maintenance of other property values according to the presence of certain natural features. Finally, the arrow symbol indicates that society or the individual must regulate land use decisions to protect a value, for under certain circumstances society has found its community values to be of higher priority than individual. The matrix indicates, for instance, residential development may pre-empt valuable natural, social, or esthetic resources that should be preserved for continued appreciation by a wider segment of the community, and, therefore, that regulations should be written to make the community's judgement on these matters explicit.

The so-called performance standards developed from the analysis of the inventory can take a variety of forms. One type of standard could be referred to as a natural performance standard:[13] the most common example is from stormwater management, where maximum permissable rates of runoff from developed land can be spelled out. Here, the standard can be written entirely in terms of natural functions, and development activity on the land is theoretically not constrained at all so long as it permits the natural systems to perform as specified. Other natural performance standards could be written for groundwater recharge (e.g., the land after development must remain capable of absorbing X gallons of water per acre per day), permissable erosion rates, water quality in streams, etc. The use of natural performance standards is limited, however, by lack of knowledge of what standards are appropriate, difficulties in measuring performance, and administrative problems, i.e., enforcement.

One step removed from a natural performance standard are regulations about maximum disturbances permissable to a natural environment. For instance, the Runoff Management Chart, presented as Table 43, also contains Medford's performance standard for runoff: it shows what percentage of land should be left open under various conditions to assure that groundwater recharge is protected and that excessive runoff is prevented. Since it is nearly impossible to measure the rate of recharge of rainfall into the ground at a particular site, approximations must be made, and developers must conform to what the town estimates to be required. Whereas a natural performance standard for groundwater disposal might imply the acceptability of an underground disposal field beneath buildings, the adopted performance standard is more prescriptive in terms of allowable techniques. In fact, most environmental performance standards are prescriptive of just how development is to occur on a particular site, with reference to a particular environmental parameter. Setbacks of septic tanks from streams or wells, application rates for pesticides and fertilizers, overall building densities and impervious surface ratios, and many other quantifiable restraints on development activity are best expressed in terms of prescriptive standards rather than in terms of natural systems.

The intent of all performance standards is to impose the minimum restriction possible on development activity, but the limits to this are quickly reached. Certain intense land uses, such as office and commercial centers, and industrial facilities, simply cannot comply with many performance standards and are, therefore, excluded by them--an example would be trying to locate parking for a regional shopping mall where percentage of land cover must be kept low to protect aquifer recharge. For less intense land uses, conformance with standards may drastically raise the price of construction--for instance, buildings might be permitted in a floodplain so long as they stand on stilts above the high water mark of the hundred year flood. Such standards amount to land use restriction wherever the cost of complying with them is higher than the possible return to the developer.

The strength of the review process proceeds from the logic of its development. So long as the performance standards adopted by the town are reasonable, both in their environmental goals and in their constraints on development, they provide an efficient and practical method of enhancing local environmental quality.

Sample performance standards and land use restrictions covering a few basic mapping categories are reproduced as Table 46. These are taken only from the Medford Township Study, and are meant to be illustrative.

Table 46

Selected Performance Standards

MAP	MAPPED ZONES	PERFORMANCE STANDARDS
Flood Hazard	Floodprone Areas	-No permanent habitation. -No structures or other artifacts permitted which are likely to cause liability to the Township or any other property or persons during floods. -No structures or other artifacts permitted which will impinge upon the floodable cross-section area at any point along the water flow channel.
Water Table	Seasonal High Water Table 0 to 1 Foot	-No permanent habitation -Application of fertilizers restricted to those types and amounts which will ensure their ready absorption by the local vegetation. In no case shall the concentration of nutrients in the groundwater over these areas be allowed to exceed the acceptable standards for adjacent surface waters. -No disruption of the free flow of water from these areas to adjacent surface waters.
	Seasonal High Water Table 1 to 5 Feet	-Application of fertilizers restricted to those types and amounts which will ensure their absorption by the local vegetation and soils to ensure no increase in concentration of nutrients beyond present levels at a depth of one foot below the ground surface. -No development of septic tank drainage fields. -Sewers required to have leak-proof joints.

(continued on following page)

Table 46 (continued)

		-No disruption of the free flow of underground movement of water.
Erosion Management	Over 25/Tons/Acre/ Year 5 to 25 Tons/Acre/ Year Up to 5 Tons/Acre/ Year	(all) -Soil loss restricted to 3 tons/ acre/year at all times including all stages of development. All remedial steps such as check dams, silt trapping levees, terracing, etc. to be located outside of the Surface Water Features (stream, lake, marsh, flood-plain) identified on the Hydrology Map.
		-In areas of Qualified Soil loss, no alteration of the existing water table permitted, unless provision of erosion control listed above is ensured.
Scenic Resource	Enclosed Area	-No disruption permitted of the physical and visual continuity.
		-Thinning of or clearing within the wooded parts permitted only if it maintains the visual integrity of existing woodlands.
		-No disruption permitted of the visual continuity along the upper rim of these enclosures.
	Areas of Regional & Local Prominance	-No disruption permitted of the visual continuity of skyline and upper slopes of these hills.
		-No visual obstruction permitted of the base of these hills.
	Terrain Interest	-No disruption permitted of the physical and visual continuity.
		-No obstruction permitted of the long views from these slopes.

SOURCE: Narendra Juneja, Medford, Performance Requirements for the Social Values Represented by Natural Environment of Medford Township, New Jersey, Center for Ecological Research, Univ. Of Penn., 1974.

COSTS OF IMPLEMENTATION

Municipalities traditionally resist spending money for planning purposes because planning often has little direct benefit. Planning monies available through HUD Community Development Block Grant program may, however, be used for conducting the environmental review process recommended here: under the provisions of the Act, funds for planning are released unconditionally following approval of a community's application. This can act as a bootstrap procedure: use of a subdivison or site review process as recommended here can be an efficient way to expedite the environmental reviews for other projects. The result can be cost savings in the reviews for federally-funded projects, and a system for low-cost environmental analysis of all development.

Public Costs

As emphasized above, the success of the recommended local impact review process stands on the willingness of a town to undertake a valid natural resource inventory and develop or adopt explicit performance standards for development. The costs of these vary widely according to the depth of the analysis undertaken and the number of performance standards desired. If a large scale gridmapping is done of a region, performance standards may be left up to local towns to develop.

Although the costs of implementing a review process may seem high by the standards of many communities, the direct dollar benefits associated with an environmental review process are also substantial, and may be worth far more in the future than the $6,000 to $8,000 a town might spend on a simple inventory and analysis, using some volunteer labor. In the case of Medford Township, whose elaborate experimental inventory cost $150,000, costs have almost been recovered only two years after its completion.[14] Medford's situation was unique in some respects, however. Because of pit iron mining along streams in the Nineteenth Century, artificial lakes were formed in many locations around town, making attractive housing sites for subdivisions. When houses located along these artificial lakes began to pollute them with runoff and septic tank effluent, the lakes eutrophied and became smelly and turbid. Reclaiming the lakes meant substantial expense for the town, and residents saw environmental controls on new development around the lakes as a benefit for the town. Other communities without such special circumstances may realize fewer direct cost savings as a result of conducting an environmental inventory, but on the other hand, their inventory costs need not approach those that Medford incurred.

The method used by Medford officials in convincing residents of the value of this expenditure is instructive. The proponents of the plan used recent development projects in the town to illustrate monies that could have been saved by effective environmental review. They pointed to roadways built at town expense to serve sprawled out subdivisions--not only did these represent an unnecessary capital expense, they required continuing operations and maintenance expenses: roads must be refinished and repaved periodically; city garbage trucks are forced to travel farther to collect wastes; school buses must make longer daily trips. Stormwater facilities illustrate another major category of unnecessary costs to the community: proponents convinced voters that environmental reviews could remove the necessity to build town facilities to accept drainage from poorly designed parking lots and housing developments. Furthermore, the public costs incurred through the construction of culverts, stormsewers, and other unnecessary "infrastructure" are only half the problem, for insensitively sited subdivisions can expose homeowners to private property damages from flooded basements, backed up septic tanks and land subsidence.

Grid Mapping: One computerbased land inventory was conducted in 1971 by the Bucks County Planning Commission and cost between $75,000 and $80,000[15] The inventory covered all of the county's fifty-four municipalities.

Contour Mapping: The production of contour maps is necessarily more expensive than theproduction of grid maps, since more manual labor is involved. The Town of Medford, New Jersey, was one of the first to produce a natural resource inventory for planning purposes, and their study cost $150,000. This project, however, produced some seventy-five maps, and was itself a pilot project. A number of other towns in the state have also produced inventories, and their costs have averaged about $6,000 to $8,000, the range being from $2,000 to $12,000.[16] While many of these towns have used volunteer labor extensively, others have used the services of private consultants without any major increases in total costs to the community. The product of the inventory process, whether produced professionally or not, is a set of maps and a descriptive report.

Private Costs

Data are not available on the costs borne by private developers in complying with an environmental review procedure such as presented here. Although there is no obligation for them to incur any costs for independent research on existing site conditions, most do so[17] to be sure that any restrictions on the use of their property are in fact valid. Their basic costs of compliance with the system--identifying their property on the relevant maps and any performance standards that may affect their development plans--are low, however.

Possible Market Impacts

It is possible that the use of performance standards within existing zoned areas might raise legal challenges of inverse condemnation from current owners. While not all performance standards would increase costs of development significantly, some raise it. For instance, one could go so far as to require that buildings in flood prone areas (i.e., areas that would experience minimal flood levels on a very infrequent basis--say every fifty years on average) be built on stilts above the high water mark. Other performance standards might lower the desirability of a site. For instance, setback requirements for housing near streams could lower the scenic value of a site for development. Owners of previously unrestricted property might feel that the value of their land was being unreasonably diminished, or even destroyed. Land zoned for a certain use may actually be physically unsuited for that purpose or physically suited for a prohibited use, and the action of performance standards in correcting such mistakes may be controversial.

Apparently, no such legal challenges have occurred in Medford, New Jersey, where an environmental review of subdivisions has been underway for over a year, nor have their been any informal complaints.[18] It seems inevitable, that the very compilation of synthetic maps showing the most environmentally suitable development areas would eventually channel market interest into those properties, possibly at the expense of other property values. At present, however, developers are not aware of the potential of the system to guide their selection of properties to those with the lowest development costs, and until this happens, no conclusions can be drawn about the net impact of the environmental review process on local land markets. If market values do not depart dramatically from existing values, and if serious inconsistencies do not exist between the zoning of land and its physical ability to support development, the legal issue of inverse condemnation should not be serious.

SAMPLE ORDINANCES

The implementation of environmental impact statement (EIS) ordinances has become rather widespread in recent years. Ordinarily, the EIS requirement is appended to an existing subdivision control ordinance. In that case, the community's planning board is charged with review of the EIS in the course of subdivision review and approval. There is no obvious impediment to extending the EIS process to local activities and developments other than subdivision, although this may well require the creation of a new community review board to receive and respond to the EIS.

The first model EIS ordinance included below (that of Lincoln, Massachusetts), is representative of the majority of such ordinances now in place. Its language cuts a rather broad swath, and the guidance provided for the actual preparation of the EIS is minimal. Nevertheless, this ordinance would assist a planning or zoning board in upgrading the informational base upon which it makes its decision.

The second EIS ordinance included below has been implemented by Medford Township in New Jersey. It will be noted that the ordinance is drafted in far greater detail that the Lincoln model, and is intended to accomplish a much more carefully designed process of environmental review. The foundation of the Medford approach is an extensive and detailed inventory of the town's environment and resources; communities wishing to adopt its format would have to undertake a similar inventory.

Except for the EIS provisions, the Medford ordinance represents a fairly straightforward subdivision control law, and is designed to be included in Medford's subdivision review process. Note, however, that unlike the Lincoln EIS ordinance, Medford succeeds in giving the developer detailed guidance regarding the preparation and expected contents of the EIS, and the data to be used.

A noticeable quirk in the Medford approach is the incorporation of the Ecological Planning Study (with its regulations) in the "statement of purposes," but not in the actual operative ordinance provisions dealing with control processes. It would be advisable for a community following the Medford approach to incorporate the inventory by reference in the entire ordinance, and especially in those portions of the ordinance which deal with the submission of plans, the permitting powers of the planning board and enforcement.

ORDINANCE OF THE TOWN OF LINCOLN, MASSACHUSETTS

ENVIRONMENTAL IMPACT STATEMENT

The applicant shall also submit an environmental impact statement, the purpose of which is to enable the officials of the Town to determine what methods are used by the applicant to promote the environmental health of the community and to minimize adverse effects on the natural resources of the Town.

In preparing the statement, the applicant should refer to the sets of Environmental Quality Maps, Town of Lincoln, 1971, and to the Soil Survey Maps and Manual, preparation for Lincoln by the Soils Conservation Service, U.S. Department of Agriculture, on file at the Town Hall. The statement should include specific references to the appropriate plans and maps. The statement should be a technical document with references for all statements whenever possible.

In reviewing the statement, the Town boards will consider the degree to which water is recycled back into the ground, the maintenance and improvement of the flow and quality of surface waters; the preservation or promotion of wildlife refuges, historic sites, unique geological botanical and archaeological features, existing or potential trails and accesses to open space areas; and the health and safety of the inhabitants of the area.

The Planning Board may waive any section, or sections, of the Statement which it deems inapplicable to the proposed project. The developer should discuss the requirements with the Board prior to preparation of the Statement, preferably prior to the submission of a tentative plan.

The Statement shall include the following:

(1) Physical Environment.

1. Describe the general physical conditions of the site, including amounts and varieties of vegetation, general topography, unusual geologic, scenic and historical features, trails and open space links, and indigenous wildlife.
2. Describe how project will affect these features.
3. Provide a complete physical description of the project, and relationship to surrounding area.

(2) Surface Water and Soils.

1. Describe location, extent and type of existing water and wetlands, including existing surface drainage characteristics, both within and adjacent to the project.
2. Describe the methods to be used during construction to control erosion and sedimentation; i.e., use of sediment basins and type of mulching, matting, or temporary vegetation; describe approximate size and location of land to be cleared at any given time and length of time of exposure; covering of soil stockpiles; and other control methods used. Evaluate effectiveness of proposed methods on the site and on the surrounding areas.
3. Describe the permanent methods to be used to control erosion and sedimentation. Include description of
   a. any areas subject to flooding or ponding;
   b. proposed surface drainage system;
   c. proposed land grading and permanent vegetative cover;
   d. methods to be used to protect existing vegetation;
   e. the relationship of the development to the topography;
   f. any proposed alterations of shore lines, marshes or seasonal wet areas;
   g. any existing or proposed flood control or wetland easements;
   h. estimated increase of peak run-off caused by altered surface conditions, and methods to be used to return water to soils.

4. Completely describe sewage disposal methods. Evaluate impact of disposal methods on surface water, soils, and vegetation.

(3) Sub-surface Conditions.

1. Describe any limitations on proposed project caused by sub-surface soil and water conditions, and methods to be used to overcome them.

2. Describe procedures and findings of percolation tests conducted on the site.

3. Evaluate impact of sewage disposal methods on quality of sub-surface water.

(4) Town Services.

1. Describe estimated traffic flow at peak periods and proposed circulation pattern.

2. Describe locations and number of vehicles accommodated in parking areas.

3. Describe effect of project on police and fire protection services.

4. Describe effect of project on public works department services.

5. Describe effect of project on educational services.

6. Describe the effect of the project on the town water supply and distribution system.

(5) Human Environment.

1. Provide a tabulation of proposed building by type, size (number of bedrooms, floor area), ground coverage, and a summary showing the percentage of the trace to be occupied by buildings, parking and other paved vehicular areas, and usable open space (Section VII-C-3-b of the Zoning By-Law).

2. Describe type of construction, building materials used, location of common areas, location and type of service facilities (laundry, trash, garbage disposal).

3. State proximity to transportation, shopping and educational facilities.

4. Describe proposed recreational facilities, including active and passive types; and age groups participating, and state whether recreational facilities and open space are available to all Lincoln residents.

(6) General Impact.

1. Summarize briefly environmental impact on entire town with supporting reasons.

SOIL SURVEY

Where appropriate, the Board may require soil surveys to establish the suitability of the land for the proposed storm and sanitary drainage installations.

TOWN OF MEDFORD: ORDINANCE NO. 1974-11

AN ORDINANCE ESTABLISHING RULES, REGULATIONS AND STANDARDS GOVERNING THE SUBDIVISION OF LAND WITHIN THE TOWNSHIP OF MEDFORD PURSUANT TO THE AUTHORITY SET FORTH IN CHAPTER 433 OF THE LAWS OF 1953, AND AMENDMENTS AND SUPPLEMENTS THERETO; SETTING FORTH THE PROCEDURE TO BE FOLLOWED BY THE PLANNING BOARD AND THE GOVERNING BODY IN APPLYING AND ADMINISTERING THESE RULES, REGULATIONS AND STANDARDS; AND PROVIDING PENALTIES FOR THE VIOLATION THEREOF.

BE IT ORDAINED AND ENACTED by the Township Committee of the Township of Medford, as follows:

ARTICLE I - TITLE

Section 1. This Ordinance shall be known and may be cited as "The Land Subdivision Ordinance of the Township of Medford."

ARTICLE II - PURPOSE

Section 1. The purpose of this ordinance shall be to provide rules, regulations and standards for land subdivision in the Township of Medford in order to promote and protect the public health, safety, general welfare of the municipality in such a manner as not to affect adversely the environmental integrity of the ecosystem continuity of the municipality, and where reasonably possible, to maintain or to enhance both.

It shall be administered to insure the orderly, fair and equitable growth and development, conservation, protection and proper use of land and all other natural and man-made resources of the municipality and adequate provision for circulation, utilities, services and other elements essential for maintenance and provision of a good environment and quality of life within the municipality and to ensure compliance with all pertinent laws of the State of New Jersey and the United States of America.

To assist in accomplishing these purposes the municipality has caused to be prepared an Ecological Planning Study of the Municipality which has been reviewed and approved by the governing body of the municipality and this ordinance has been amended to adopt and reflect in large measure the conclusions and recommendations of such Ecological Planning Study.

The Ecological Planning Study has been published and has been deposited with the Municipal Clerk, and is available for public inspection.

The texts, maps and recommended regulations of the Ecological Planning Study are incorporated here by reference as considerations and findings of fact in the contemplation and legislative history of this ordinance. In addition the Township Committee incorporates the following statement.

The residents and the government of Medford Township have recognized the inevitability of growth and have committed their Township to responsible absorption of that growth. The residents and government also recognize that by virtue of the Township's unique and invaluable natural resources the Township is exposed to a high degree of ecological and fiscal vulnerability to irresponsible land use. Further, the Township has studied the failures and abuses of conventional land use and land planning and finds that irresponsible land use, even in less vulnerable areas, has resulted in severe destruction and degradation of natural resources, inestimable public costs and social inequity. Open space, clean water, vegetation and visual and aesthetic delights having motivated choice of housing location, those attributes often are progressively eliminated by progressive housing construction. In addition, the Township finds that inadequate and inflexible controls of layout and design and ignorance of ecological values have encouraged housing uniformity, unnecessary ecological costs and isolation by nonintegrated and unitary development.

The Township further finds that property conceived development may offer ecological preservation, variety of design and layout, retention of open space and vegetation, and community integrity and orientation without excessive cost. In particular, the Township Committee finds in the State and Judicial statutes an expression of public policy and a high municipal duty to preserve and protect the ecological systems of the Township and its region.

ARTICLE III - ADMINISTRATION

Section 1. The approval provisions of this ordinance shall be administered by the governing body after favorable referral by the Medford Township Planning Board in Accordance with Section 14 of Chapter 433 of the Laws of 1953.

ARTICLE IV - DEFINITIONS

When used herein the following words or phrases shall be deemed to have the meanings indicated:

Section 1. Subdivision. The division of a lot, trace or parcel of land into two or more lots, sites or other divisions of land for the purpose, whether immediate or future, of sale or building development; except that the following divisions shall not be considered subdivisions; provided, however, that no new streets or roads are involved; divisions of land for agricultural purposes where the resulting parcels are three acres or larger in size, divisions of property by testamentary or intestate provisions, or divisions of property upon court order. Subdivision also includes re-subdivision and where appropriate to the context, relates to the process of subdividing or to the lands or territory divided.

Section 2. Plat. Means a map of a subdivision.

Section 3. Sketch Plat. The sketch map of a subdivision of sufficient accuracy and detail to be used for the purpose of discussion and classification meeting the requirements of Article VI of this ordinance.

Section 4. Minor Subdivision. Any subdivision containing not more than two lots fronting on an existing improved street, not involving any new street or road or the extension of municipal facilities, not creating a lot or lots whose natural characteristics would render difficult or impossible uses of the land and not adversely affecting the development of the remainder of the parcel or adjoining property and not in conflict with any provision or portion of the master plan, official map, zoning ordinance or this ordinance. Any application to re-subdivide any lot or parcel of land previously subdivided pursuant to this or any previous subdivision ordinance of this Township shall be deemed to be a major subdivision unless the Planning Board expressely waives this requirement.

Section 5. Major Subdivision. All subdivisions not classified as minor subdivisions.

Section 6. Preliminary Plat. A preliminary map indicating the proposed layout of the subdivision which is submitted to the municipal clerk for planning board consideration and tentative approval, together with such supplemental materials as may be required herein, or which may be filed with a preliminary plat and accepted for filing, including amendments thereof or supplements thereto later filed and accepted for filing, and meeting the requirements of Article VI of this ordinance.

Section 7. Final Plat. A final map of all or a portion of the subdivision, together with the supplemental materials filed (and accepted for filing), with the preliminary plat, which are presented to the planning board for final approval in accordance with these regulations and which, if approved, shall be filed with the proper county recording officer.

Section 8. Subdivision Committee. A committee of at least three planning board members appointed by the chairman of the board for the purpose of classifying subdivisions in accordance with the provisions of this ordinance and such other duties relating to land subdivision which may be conferred on this committee by the board.

Section 9. Subdivider. Any individual, firm, association, syndicate, co-partnership, corporation, trust or any other legal entity commencing proceedings under this ordinance to effect as subdivision of land hereunder for himself or for another.

Section 10. Owner. Any individual, firm, association, syndicate, co-partnership or corporation having sufficient proprietary interest in the land sought to be subdivided to commence and maintain proceedings to subdivide the same under this ordinance.

Section 11. Performance Guarantee. Any security which may be accepted in lieu of a requirement that certain improvements be made before the planning board or other approving body approves a plat, including performance bonds, escrow agreements, and other similar collateral or surety agreements.

Section 12. Master Plan. A composite of the mapped and written proposals recommending the physical development of the municipality, which shall have been duly adopted by the planning board.

Section 13. Official Map. A map adopted in accordance with the Official Map and Building Permit Act. Chapter 434 of the Laws of 1953, or any prior act authorizing such adoption. Such a map shall be deemed to be conclusive with respect to the location and width of the Streets, public parks and playgrounds and drainage right-of-way shown thereon.

Section 14. Lot. A parcel or portion of land separated from other parcels or portions by description as on a subdivision or record of survey, map, tax map, or by metes and bounds for purposes of sale, lease or separate use.

Section 15. Street. Any street, avenue, boulevard, road, land parkway, bicycle or pedestrian path, alley or other way which is an existing state, county or municipal roadway, or a street or way shown upon a plat heretofore approved pursuant to law or approved by official action or a street or way on a plat duly filed and recorded in the office of the county recording officer prior to the appointment of a planning board and the grant to such board of the power to review plats and a street or way shown on the official map, and includes the land between the street lines whether improved or unimproved, and may comprise pavement, shoulders, gutters, sidewalks, parking areas and other areas within the street lines. For the purpose of this ordinance streets shall be classified as follows:

(a) Arterial streets are those which are used primarily for fast or heavy traffic.

(b) Collector streets are those which carry traffic from minor streets to the major system of arterial streets, including the principal entrance streets of a residential development and streets for circulation within such a development.

(c) Minor streets are those which are used primarily for access to the abutting properties.

(d) Marginal access streets are streets which are parallel to and adjacent to arterial streets and highways; and which provide access to abutting properties and protection from through traffic.

(e) Alleys are minor ways which are used primarily for vehicular service access to the back or the side of properties otherwise abutting on a street.

(f) Bicycle Paths and Pedestrian Paths. Those paths which are to be used primarily by bicycle riders or persons for walkways.

Section 16. Drainage Right-of-Way. The lands shown as drainage rights-of-way upon the official map or lands required for the installation of storm water sewers or drainige ditches and swales for retention, holding or recharge or required along a natural stream or water-course for preserving the channel and providing for the flow of water therein to safeguard the public against flood damage in accordance with chapter one of Title 53 of the Revised Statutes.

Section 17. Ecological Planning Study. A study commissioned by the municipality in 1970 by the Center for Ecological Research in Planning and Design, Department of Landscape Architecture and Regional Planning, University of Pennsylvania, including:

(1) A document entitled "An Ecological Planning Study for Medford Township, New Jersey" available for inspection at the office of the Medford Township clerk.

(2) A document entitled "An Ecological Planning Study of Medford Township, Medford, New Jersey. Draft: Summary Conclusions;" and

(3) The Ecological Map Atlas as herein defined.

(4) The findings and recommendations of the Center's research staff and its consultant as contained in the Technical Reports on each subject investigated, as described in the introduction to the "Draft: Summary Conclusions;" and

(5) Photographic slides of each of the nineteen maps identified in said draft as described above and numerous related photographic slides depicting maps, charts, graphs and associated ecological data and available for public use and inspection at the office of the Medford Township Clerk.

Section 18. Ecological Map Atlas. An atlas of maps at a scale of 1" = 2000' designated "Ecological Map Atlas" available for public use and inspection at the office of the Medford Township Clerk.

Section 19. Environmental Impact Statement. This shall mean a statement with respect to Environmental and Ecological impacts of the proposed subdivision prepared and filed as provided in Article VI hereof.

ARTICLE V - PROCEDURE AND FEES

Section 1. Submission of Sketch Plat.

(a) Any owner of land within the Township of Medford shall prior to subdividing or resubdividing land, as defined in this ordinance, submit to the Secretary of the Planning Board (or other designated official) at least two weeks prior to the regular meeting of the Board a sketch plat and six copies thereof of the proposed subdivision for purposes of classification and preliminary discussion, as well as the submission of proof that no taxes or assessments for local improvements are due or delinquent on the property involved.

(b)(1) If classified and approved as a minor subdivision by unanimous action of the subdivision committee, a notation to that effect will be made on the sketch plat.

The plat will then be forwarded to the Mayor and the Municipal Clerk for their signature and returned to the subdivider within one week following the next regular meeting of the governing body. No further governing body approval shall be required but no such certification shall be construed to constitute a waiver of any requirement for the submission of subdivision applications to the County Planning Board for review and approval as set forth in P.L. 1968, C 285, See 40:27-6(6).

(c) Before the Municipal Clerk returns any approved sketch plat to the subdivider, the Clerk shall have sufficient copies made to furnish one (1) copy to each of the following:

(1) Municipal Clerk
(2) Municipal Engineer
(3) Building Inspector or Zoning Officer
(4) Tax Assessor
(5) Secretary of the Planning Board
(6) County Planning Board

The cost of the copies will be charged to the subdivider and shall be collected before the return of the original sketch plat to the subdivider.

(d) Either a deed description or plat map drawn in compliance with Chapter 358 of the Laws of 1953 shall be filed by the subdivider with the county recording officer within 90 days from the date of return of the approved sketch plat.

(e) If the plat is classified as a major subdivision, a notation to that effect shall be made on the plat which will be returned to the subdivider for compliance with the procedure in Section 2 and 3 of this Article.

(f) There shall be a filing fee for all subdivisions submitted for classification and discussion of $25.00.

(g) For Major subdivisions the following fees shall be paid:

1. Preliminary Plat:
    - a. Filing fee, $100.00
    - b. Professional review, $25.00 per lot plus $100.00 per acre devoted to nonresidential development.
2. Final Plat:
    - a. Filing fee, $50.00
    - b. Professional review, $15.00 per lot.
    - c. Inspection, site improvements, at the rate of six per cent (6%) of the Engineer's estimated cost of improvements to be paid at the time final approval is granted prior to start of construction of any off-site improvements.
3. After preliminary approval, applicant or his Agents shall notify the Township Engineer at least twenty-four hours prior to start of construction of any off-site improvements.

(g) All fees, except the filing fee, mentioned herein shall be paid into an escrow account to be held by the Township to pay professional personnel to process, review, make recommendations on the proposed plat and the inspection of improvements.

If, during the existence of this escrow account, the balance of funds held by the Township shall be insufficient to cover vouchers submitted by the professionals, applicant shall within fourteen (14) days from the data of receipt of written notice deposite additional sums with the Township to cover the amount of the deficit and the anticipated amount to cover all remaining work.

All excess monies in the escrow account will at the time of the final release of maintenance bonds for improvements be returned to the applicant with a statement of money expended against the account. If, at any time prior to final approval the applicant elects to withdraw his request for approval and abandon the project, any monies remaining in the escrow account after all proper charges have been paid will be returned to the applicant with a statement of money expended against the account.

Section 2. Submission of Preliminary Plat of Major Subdivision for Tentative Approval.

(a) At least ten black on white prints of the preliminary plat and one transparency on cloth, together with five copies of any other documents required in connection therewith shall be submitted to the Municipal Clerk who shall immediately notify the Secretary of the Planning Board upon receipt of a preliminary plat. The Municipal Clerk shall retain one copy of said preliminary plat and forward the remaining copies of the Secretary of the Planning Board. At the time of the submission the subdivider shall pay the fees as established by the Planning Board above.

(b) Copies of the preliminary plat shall be forwarded by the Secretary of the Planning Board for comment and report to the following:

1. Secretary of the County Planning Board
2. Municipal Engineer
3. Secretary of the Board of Health
4. Burlington County Soil Conservation Service, USDA
5. Chairman, Environmental Commission on the Township of Medford
6. Medford Township Ecological Consultants (if ten or more lots are involved)
7. Zoning Officer
8. Municipal Sewerage Engineer.
9. Such other municipal, county or state officials as directed by the Planning Board.

(c) Upon receipt of the reports from the appropriate bodies as required by the Planning Board of those set forth above, the Secretary of the Planning Board shall notify the applicant in writing that the Planning Board is prepared to hear the matter on an agreed date within sixty-five days unless extended by agreement with the applicant and shall advise the applicant to notify by certified or registered mail, at least five days prior to the hearing, all property owners within 200 feet of the extreme limits of the subdivision as their names and addresses appear on the municipal tax record. Said notice shall state the time and place of hearing, a brief description of the subdivision, including the amount of acres, number of lots proposed and the block and lots involved, and that a copy of said subdivision has been filed with the municipal clerk for public inspection. The applicant shall also cause notice of the hearing to be published in the official newspaper or a newspaper of general circulation in the municipality at least ten days prior to the hearing. Proofs shall be submitted by the applicant of compliance prior to the hearing.

(d) The Planning Board shall act and notify the applicant on the preliminary plat within sixty-five days after public hearing, but in no case before the expiration of the thirty day period within which the County Planning Board may submit a report on said subdivision. In all cases the recommendations of the county board shall be given careful consideration in the final decision of the local planning board. If the County Planning Board has approval authority pursuant to R.S. 40:27-12, its action shall be noted on the plat, and if disapproved two copies of the reasons for disapproval shall be returned with the plat. If either the Planning Board or County Planning Board disapprove a plat, the reasons for disapproval shall be remedied prior to further consideration.

(e) If the Planning Board acts favorably on a preliminary plat, a notation to that effect shall be made on the plat, and it shall be referred to the governing body for action. The governing body shall act within two regular meetings. Its action shall be noted on the plat, signed by the Mayor and be returned to the subdivider for compliance with final approval requirements.

(f) Preliminary approval shall confer upon the applicant the following rights for a three-year period from the data of approval:

1. That the general terms and conditions under which the preliminary approval was granted will not be changed.

2. That the said applicant may submit on or before the expiration date the whole or part or parts of said plat for final approval.

Section 3. Improvements or Guarantees Prior to Final Approval. Before consideration of a final subdivision plat, the subdivider will have installed the improvements required under Article VII or the Planning Board shall require the posting of adequate performance guarantees to assure the installation of the required improvements.

Section 4. Submission of Final Plat of Major Subdivision.

(a) The final plat shall be submitted to the municipal clerk for forwarding to the Planning Board for final approval within three years from the date of tentative approval. Upon its receipt the Municipal Clerk shall forthwith forward all but one copy of said final plat together with related documents to the Secretary of the Planning Board. The Planning Board upon receipt of the final plat and its related documents shall act upon the final plat within forty-five days from the date of submission for final approval to the municipal clerk. At the time of the submission of said final plat to the municipal clerk by the subdivider, the subdivider shall pay the fees to be used to offset the cost of professional service and other incidental expenses connected with processing, reviewing and checking the material submitted.

(b) The original tracing, one translucent tracing cloth copy, two cloth prints, 10 black on white prints and three copies of the application form for final approval shall be submitted to the Secretary of the Planning Board at least ten days prior to the date of the regular Planning Board meeting. One cloth print shall become part of the Township's permanent file and one translucent shall be forwarded to the Township Engineer. Unless the preliminary plat is approved without changes, the final plat shall have incorporated all changes or modifications required by the Planning Board.

(c) The final plat shall be accompanied by a statement by the municipal engineer that he is in receipt of a map showing all utilities in exact location and elevation identifying those portions already installed and those to be installed and that the subdivider has complied with one or both of the following:

1. Installed all improvements in accordance with the requirements of these regulations, or

2. A performance guarantee has been posted with the Municipal Clerk in sufficient amount to assure the completion of all required improvements. No such bond shall be released until receipt of a map showing all utilities in exact location and elevation.

(d) Any plat which requires county planning board approval pursuant to R.S. 40:27-12 shall be forwarded to the county planning board for its action prior to final approval by the governing body.

(e) If the planning board favorably refers a final plat to governing body, the governing body shall take action not later than the second regular meeting following the referral, noting its action on the plat and the Mayor affixing his signature thereto if said action is favorable.

(f) Failure of the planning board and governing body to act within the alloted time or a mutually agreed upon extension shall be deemed to be favorable approval and the municipal clerk shall issue a certificate to that effect.

(g) If any person shall be aggieved by the action of the planning board, appeal in writing to the governing body may be taken within ten days after the date of the action of the planning board. A hearing thereon shall be had on the notice to all parties in interest who shall be afforded an opportunity to be heard. All parties in interest shall include all property owners within two hundred feet and all parties previously notified. After such hearing the governing body may affirm or reverse the action of the planning board by a recorded vote of a majority of the total members thereof. The findings and reasons for the disposition of the appeal shall be stated on the records of the governing body, and the applying party shall be given a copy.

(h) Upon final approval, copies of the final plat shall be filed by the planning board with the following:

1. Municipal Clerk
2. Municipal Engineer
3. Building Inspector
4. Tax Assessor
5. County Planning Board
6. Official issuing certificates for approved lots.
7. Site Plan Officer
8. Plumbing Inspector
9. Superintendent of Sewage Treatment Plant.

(i) The final plat after final approval by the governing body shall be filed by the subdivider with the County recording officer within 90 days from the date of such approval. If any final plat is not filed within this period, the approval shall expire.

(j) No plat shall be accepted for filing by the county recording officer unless it has been duly approved by the governing body of Medford Township and signed by the Mayor.

ARTICLE VI - CONTENTS OF SUBMISSIONS

Section 1. Sketch Plat. The sketch plat shall be based on tax map information or some other similar accurate base at a scale of not less than 400 feet to the inch to enable the entire trace to be shown on one sheet and shall show or include the following information:

(a) The location of that portion which is to be subdivided in relation to the entire tract.

(b) All existing structures and wooded areas within the portion to be subdivided and within 200 feet thereof.

(c) The name of the owner and of all adjoining property owners as disclosed by the most recent municipality tax records.

(d) The tax map sheet, block and lot numbers.

(e) All streets or roads, ditches, streams and lakes within 500 feet of the subdivision.

(f) All existing easements on or affecting said tract.

(g) All existing zoning of said tract and adjacent tracts.

Section 2. Preliminary Plat.

A. The preliminary plat shall be clearly and legibly drawn or reproduced at a scale of not less than one inch equals 100 feet. Preliminary plats shall be designed and drawn by a Professional Engineer legally qualified and licensed within the State of New Jersey. The plat shall be designed in compliance with the provisions of Article VIII of this ordinance and shall show or be accompanied by the following information:

(1) A key map showing the entire subdivision and its relation to surrounding area at a scale of one inch equals two thousand feet.

B. The tract name, tax map, sheet, block and lot number, number of proposed lots, date, reference meridian, graphic scale and the following names and addresses:

(1) Name and address of record owner or owners
(2) Name and address of subdivider
(3) Name and address of person who prepared map.

C. Acreage of tract to be subdivided to nearest tenth of an acre; square footage of each proposed lot.

D. Contours at 2-foot intervals for entire area of property as well as lands immediately adjacent thereto of sufficient scope to determine the effect upon the relationship of the adjoining property.

E. Complete topographical data showing all natural and man made features within or adjacent to the tract, including but not limited to such features as streets, buildings, water courses and water tables, lakes, wood lands, field, meadow, marshes, hills, general types and location of vegetation and trees, culverts, storm sewers, water lines, sanitary sewer lines, gas and electric and telephone lines.

F. Complete outbound survey of entire tract, including any exceptions and easements affecting the subdivision.

G. Plan or plans showing layout to scale accuracy of proposed property lines, streets, sanitary sewers, storm drains, ditches, water lines, buildings, relocated streams, proposed fire hydrants, street signs, easements or covenants, and any other features connected with the subdivision of land and construction of improvements thereon.

H. Copies of design criteria and calculations; complete specifications covering materials and methods of construction for all improvements; typical details for all appurtenances and typical cross sections of streets.

I. When an individual water supply and/or sewerage disposal system is proposed, the plan for such system must be approved by the appropriate local, county or state health agency. When a public sewage disposal system is not available, the developer shall have percolation tests made and submit the results with the preliminary plat. Any subdivision or part thereof which does not meet with the established requirements of this ordinance or other applicable regulations shall not be approved. Any remedy proposed to overcome such a situation shall first be approved by the appropriate local, county or state health agency.

J. Probable impact on municipal services, including water, storm sewers, sewerage disposal, schools, police and fire protection, roads and traffic, sanitation and trash disposal, with supporting data, to show how conclusions were determined.

K. Effect of the proposed development upon the ecological balance in the lands and waters (both surface and ground) of the township and neighboring townships, the lands and waters in proximity to the proposed subdivision and the lands and waters within the tracts of land encompassed by the subdivision.

L. An environmental impact statement containing:

1. Nineteen maps of the subdivision derived by the applicant from each of the nineteen maps of the Ecological Map Atlas.

2. The recommended regulations appropriate to the subdivision as indicated by the maps of the Ecological Map Atlas and derived by the applicant from the recommended regulations and summary conclusions described in Article IV, Section 17. hereof.

3. Such additional Ecological Data as the applicant may desire to submit.

4. A statement describing and explaining the impact and effect of the proposed subdivision upon the ecological systems and environment of Medford Township's lands and waters, giving consideration to the applicable natural processes and social values of:

a. Geology.
b. Aquifers.
c. Hydrology.
d. Depth to seasonal high water table.
e. Run-off management units.
f. Soils.
g. Potential soil loss
h. Soil nutrient retention
i. Vegetation.
j. Recreation value of vegetation.

k. Terrestrial wildlife habitation
l. Historic value
m. Physiography
n. Microclimate
o. Scenic units
p. Limnology
q. Wildlife - high value areas
r. Wildlife - hazardous and nuisance species
s. Wildlife - rare and beneficial species.

5. By reference to the summary conclusions and recommended recommendations, the statement shall identify specifically which of the four categories and subcategories of regulation described below are, or are not applicable to the proposed subdivision, and where a category of regulation is deemed to be applicable; a description shall be furnished of the action proposed to be taken or avoided to minimize any adverse effect on environment or ecology, or to benefit the environment or ecology. The categories and subcategories involved are those set forth below designated categories A through D, as follows:

a. Category A - regulations to avoid hazard to life and property from:

Subcategory 1. Flood
Subcategory 2. Fire.

b. Category B - regulations to prevent hazard to life and health resulting from human activities related to use of:

Subcategory 1. Surface waters
Subcategory 2. Water table
Subcategory 3. Nutrient application.

c. Category C - regulations to minimize loss of unique, scarce and valuable resources:

Subcategory 1. Historic
Subcategory 2. Vegetation
Subcategory 3. Wildlife
Subcategory 4. Scenic
Subcategory 5. Water recharge
Subcategory 6. Geologic.

d. Category D - regulations to minimize social costs by proper management of:

Subcategory 1. Aquifers
Subcategory 2. Soil loss
Subcategory 3. Vegetation
Subcategory 4. Recreation use of vegetation
Subcategory 5. Wildlife habitats
Subcategory 6. Land use.

M. In reviewing an Environmental Impact Statement, the planning board may refer the statement to a qualified consultant at applicants expense to obtain comments and suggestions with respect hereto, and may consider such information in deciding whether to approve, request modifications or formulate general terms or conditions subject to which approval may be given, or reject the applicant.

N. Specific plans proposed by the subdivider to alter, preserve or enhance existing vegetation, including landscaping and topographical and natural features of the land within the proposed subdivision.

O. Areas proposed to be reserved as open space delineating those areas to be preserved in their natural state or for recreation purposes such as playing fields and playgrounds, and proposed method of ownership and maintenance of the areas.

P. Sufficient number of borings, to be a depth of not less than eight feet below the proposed finish grade to indicate soil types and depth and elevation of the water table on the entire tract.

Q. Submission of proof that no taxes or assessments for local improvements are due or delinquent on the property involved.

Section 3. Alternative Procedure for Preliminary Environmental Impact Assessment. In recognition of the substantial engineering and other costs of preparation of the preliminary plat, and to encourage flexibility of design for ecological and open space purposes, the following procedure is established for preliminary assessment of environmental impact.

1. At any time prior to the submission of the preliminary plat the subdivider may submit a Preliminary Environmental Impact Statement to the Planning Board for its review and recommendations at public hearing together with such single or alternate tentative plans showing tentative design and layout of a subdivided tract as the subdivider may desire to submit.

2. The Preliminary Environmental Impact Statement shall contain all data required by Article VI, Section 2L of this ordinance except subsection 2L(4).

3. In lieu of Section 2L(4), the Preliminary Environmental Impact Statement may contain a statement of the prospective ecological impact and of the ecological advantages and disadvantages of the tentative plan or plans submitted.

4. At the expense of the applicant the Preliminary Environmental Impact Statement and the tentative plan or plans shall be submitted by the planning board to qualified consultants for review, comments and suggestions.

5. The planning board shall conduct a public review of the Preliminary Environmental Impact Statement at which the applicant and the public may offer comment, discussion and suggestions. Such hearing shall be held within two regular meetings of receipt of the consultants report.

6. In the event the applicant chooses the alternative Environmental Procedure here provided, he shall cause to be published in the official newspaper of the Township, at least five days prior to the hearing, a Notice of Preliminary Environmental Impact Review identifying the tract or tracts of land by reference to lot and block number as designated in the official tax records of the Township and giving the date, time and location fixed by the planning board for the public hearing.

7. Neither the planning board nor the applicant shall be bound by the comments, findings, suggestions and recommendations derived from this alternate procedure, nor shall use of this procedure be deemed compliance with the provisions of Article VI, Section 2L hereof.

Section 4. Final Plat. The final plat shall be drawn in ink on tracing cloth, or its equivalent, at a scale of not less than one inch equals 100 feet and in compliance with all the provisions of Chapter 358 of the Laws of 1953. The final plat shall show or be accompanied by the following:

(a) Date, name and location of the subdivision, name of owners, graphic scale and reference meridians.

(b) Tract boundary lines, right-of-way lines of streets, street names, easements and other rights-of-way, land to be reserved or dedicated to public use, all lot lines and other site lines with accurate dimensions and bearings and radii, arcs and central angles of all curves.

(c) The purpose of any easement or land reserved or dedicated to public use shall be designated, and the proposed use of sites other than residential shall be noted.

(d) Subdivider to use lot and block numbers designated by the governing body.

(e) Minimum building setback line on all lots and other sites.

(f) Location and description of all monuments.

(g) Names of owners of adjoining land.

(h) Certification by engineer or surveyor as to accuracy of details of plat.

(i) Certification that the applicant is agent or owner of the land, or that the owner has given consent under an option agreement.

(j) When approval of a plat is required by any officer or body of the municipality, county or state, approval shall be certified on the plat.

(k) Plans and profile drawings accurately drawn to a scale of not less than one inch equals fifty (50) feet showing proposed construction of off-site improvements and grading of lots complete in every detail.

(l) Copies of all other data, not included in submission of preliminary plat, necessary to completely and accurately delineate and describe the construction of off-site improvements.

(m) Certificate from tax collector that all taxes and assessments are paid.

(n) Executed and acknowledged easements to the proper governmental unit for all sanitary sewers, storm sewers and drainage rights-of-way required together with a certificate of title thereto made to the unit by a competent New Jersey Attorney or a reputable title company.

(o) A final Environmental Impact Statement or the original statement plus any amendments or supplements.

(p) All conditions of preliminary approval must be shown or noted on final plat.

ARTICLE VII - IMPROVEMENTS

Section 1. Prior to the granting of final approval, the subdivider shall have installed or shall have furnished performance guarantees for the ultimate installation of the following, if required:

a. Streets
b. Street signs
c. Curbs or curbs and gutters
d. Sidewalks
e. Street lighting
f. Shade trees of a type, size, quality and quantity as recommended by the Shade Tree Commission
g. Top soil
h. Monuments
i. Water mains
j. Storm sewers
k. Sanitary sewers
l.. Such other improvements as may be required to properly develop the subdivision, including the installation measures required to prevent erosion and siltation during and after construction.
m. Aquifer recharge basins
n. Fire hydrants.

All of the required improvements shall be installed in accordance with the rules, regulations and specifications as adopted by the planning board and such other regulations, ordinances or requirements of appropriate county or municipal bodies having jurisdication over the subject matter.

Section 2. No final plat shall be approved by the planning board until the completion of all such required improvements has been certified to the planning board by the appropriate county or municipal bodies or officers; unless the subdivision owners shall have filed with the municipality a performance guarantee sufficient in amount to cover the cost of all such improvements or uncompleted portions thereof as estimated by the municipal engineer, and assuring the installation of such uncompleted improvements on or before an agreed date. Such performance guarantee may be in the form of a performance bond which shall be issued by a bonding or surety company approved by the governing body; a certified check returnable to the subdivider after full compliance; or any other type of security approved by the governing body. The performance guarantee shall be approved by the municipal attorney as to form, legal sufficiency and execution. Such performance guarantee shall run for a period to be fixed by the planning board but in no case for a term of more than three years, which term, however, may at the discretion of the planning board be extended for an additional period or periods not to exceed the maximum period permitted by law but in no case for more than an additional three years. The amount of the performance guarantee may be reduced by the Township Committee for those portions of the required improvements after said improvements have been installed and accepted.

ARTICLE VIII - STANDARDS

The subdivider shall observe the following requirements and principles of land subdivision in the design of each subdivision or portion thereof.

Section 1. General. The subdivision plat shall conform to design standards as adopted by the Township Committee September 21, 1960, as amended from time to time, that will encourage good development patterns within the municipality. Whether either or both an official map or master plan has or have been adopted the subdivision should conform to the proposal and conditions shown thereon. The street drainage rights-of-way, school sites, public parks and playgrounds shown on an officially adopted master plan or official map should be considered in approval of subdivision plats. Where no master plan or official map exists, streets and drainage rights-of-way shall be shown on the final plat in accordance with Section 20 of Chapter 433 of the Laws of 1953 and shall be such as to lend themselves to the harmonious development of the municipality and enhance the public welfare in accordance with the design standards provided in the Environmental Impact Statement as approved, the terms of any conditions of the approval of the preliminary plat, or provided elsewhere herein.

Section 2. Streets.

(a) The arrangement of streets not shown on the master plan or official map shall be such as to provide for the appropriate extension of existing streets where deemed necessary.

(b) Minor streets shall be so designed as to discourage through traffic.

(c) Unless waived by the planning board a system of bicycle and pedestrian paths generally unrelated to and separate from streets used for vehicular access shall be shown. Design shall be oriented to ecologically suitable areas and shall be so designed as to require the minimum initial cost and maintenance costs necessary to provide safe and convenient pedestrian and bicycle access to lots.

(d) Subdivisions abutting arterial streets shall provide a marginal service road or reverse frontage with a buffer strip for planting, or some other means of separation of through and local traffic as the planning board may determine appropriate.

(e) The right of way width shall be measured from lot line to lot line. The paved width shall be measured from curb line to curb line, and, they shall be not less than the following:

1. **Arterial streets.**
   A. **Class 1 - 120 feet right-of-way**
   B. **Class 2 - 86 feet right of way.**

2. Collector streets, 66 feet right-of-way
3. Feeder streets, 60 feet right-of-way
4. Minor streets, 50 feet right-of-way
5. The right of way width for internal roads and alleys in multi-family, commercial and industrial development shall in all cases be of sufficient width and design to safely accommodate the traffic parking and loading needs and maximum access for firefighting equipment.

(f) No subdivision showing reserve strips controlling access to streets shall be approved except where the control and disposal of land comprising such strips has been placed in the governing body under conditions approved by the planning board.

(g) Subdivisions that adjoin or include existing streets that do not conform to widths as shown on the master plan or official map or the street width requirements of this ordinance shall dedicate additional width along either one or both sides of said road. If the subdivision is along one side only, one-half of the required extra width shall be dedicated.

(h) Maximum and minimum grades for all streets shall be as determined by the Planning Board.

(i) Single street intersections shall be as nearly at right angles as possible unless this requirement is waived by the planning board.

(j) Street jobs with center line offsets of less than 125 feet shall be prohibited unless this requirement is waived by the planning board.

(k) A tangent at least 100 feet long shall be introduced between reverse curves on arterial and collector streets unless wiaved by the planning board.

(l) Horizontal curves shall be of sufficient radius to provide good sight lines and safe driving conditions and shall be in accordance with minimum and maximum radius determined by the planning board.

(m) All changes in grade shall be connected by vertical curves of sufficient raidus to provide a smooth transition and proper sight distance.

(n) Dead-end streets (cul-de-sacs) shall not be longer than 800 feet and shall provide a turn around at the end with a radius of not less than 75 feet and tangent whenever possible to the right side of the street.

If a dead-end street is of a temporary nature, a similar turn around shall be provided and provisions made for future extension of the street and reversion of the excess right-of-way to the adjoining properties.

(o) No street shall have a name which will duplicate or so nearly duplicate as to be confused with the names of existing streets. The continuation of an existing street shall have the same name.

(p) Acceleration and deceleration lanes shall be provided where deemed necessary.

Section 3. Blocks.

(a) Block lengths and width or acreage within bounding roads shall be such as to accommodate the size of lot required in the area by the zoning ordinance and to provide for convenient access circulation control and safety of street traffic.

(b) In blocks over 1000 feet long, pedestrians cross walks may be required in locations deemed necessary by the planning board. Such walkways shall be 10 feet wide and be straight from curb to curb.

(c) For commercial group housing or industrial use, block size shall be sufficient to meet all area and yard requirements for such use.

Section 4. Lots.

(a) Lot dimensions and area shall not be less than the requirements of the zoning ordinance, unless waived by the planning board pursuant to the provisions of the zoning ordinance.

(b) Each lot must front upon an approved street at least 50 feet in width except lots fronting on streets described in Section 2(e)5 of this article.

(c) Where extra width has been dedicated for widening of existing streets, lots shall begin at such extra width line, and all setbacks shall be measured from such line.

(d) Where there is a question as to the suitability of a lot or lots for their intended use due to factors such as rock formations, flood conditions, drainage or other adverse environmental impact factors the planning board may after adequate investigation withhold approval of such lots.

(e) Each lot shall have designated a street number for ease in identification.

Section 5. Public Use and Service Areas.

(a) Easements along rear property lines or elsewhere for utility installation and maintenance and/or bicycle and pedestrian access may be required. Such easements shall be at least 15 feet wide and located in consultation with the companies or municipal departments concerned.

(b) Where a subdivision is traversed by a water course, drainage way, channel or stream, there shall be provided a storm water easement or drainage right-of-way conforming substantially with the lines of such water course, and such further width or construction, or both, as will be adequate for the purpose.

(c) The subdivision shall be designed to enhance and preserve the ecological and social values of the subject lands as reflected in Ecological Planning Study of Medford Township.

(d) The subdivider shall be encouraged to devote sufficient amounts of open space to secure reasonable ecological, natural, esthetic and recreational values to the inhabitants of the subdivision and the Township.

Section 6. Electric and Telephone Utilities. The subdivider shall require the serving utility to install its distribution supply lines, services and street lighting supply facilities, underground in accordance with its specifications and with the provision of the applicable Standard Terms and Conditions incorporated as a part of its Tariff as the same are then on file with the State of New Jersey Board of Public Utility Commissioners. Provided, however, that lots, which, in such subdivisions, about existing streets where overhead electric or telephone distribution supply lines have heretofore been installed on any portion of the street involved, may be supplied with electric and telephone service from those overhead lines, but the service connections from the utilities' overhead lines must be installed underground.

ARTICLE IX - VIOLATION

If, before favorable referral and final approval has been obtained, any person transfers or sells or agrees to sell, as owner or agent, any land which forms a part of a subdivision on which, by ordinance, the planning board and the governing body is required to act, such person shall be subject to a fine not to exceed two hundred ($200.00) dollars or to imprisonment for not more than thirty days and each parcel, plot or lot so disposed of shall be deemed a separate violation.

In addition to the foregoing, if the streets in the subdivision are not such that a structure on said land in the subdivision would meet requirements for a building permit under section three of the official map and building permit act (1953) the municipality may institute and maintain a civil action:

(a) For injunctive relief.

(b) To set aside and invalidate any conveyance made pursuant to such a contract or sale if a certificate of compliance has not been issued in accordance with section twenty-four of Chapter 433 of the Laws of 1953, but only if the municipality has a planning board or a committee thereof with power to act and which:

1. Meets regularly on a monthly or more frequently basis, and
2. Whose governing body has adopted standards and procedures in accordance with section twenty of Chapter 433 of the Laws of 1953.

In any such action the transferee, purchaser or grantee shall be entitled to a lien upon the portion of the land from which the subdivision was made that remains in the possession of the subdivider or his assigns, or successors, to secure the return of any deposit made or purchase price paid, and also a reasonable search fee, survey expense and title closing expense, if any. Any such acttion must be brought within two years after the date of the recording of the instrument of transfer, sale or conveyance of said land, or within six years if unrecorded.

ARTICLE X - EFFECT OF APPROVAL

Section 1. Approval of a plat shall not constitute a finding of compliance with or a waiver of the pertinent provisions of any zoning ordinance, building or sanitary code or other ordinance of the Township of Medford and it shall be the responsibility of the subdivider to obtain all necessary certificates of occupancy, building permits or other licenses from the official charged with their issuance, nor shall it constitute acceptance of any street, easement or utility or drain or sewer or other proposed public area or facility.

Section 2. Tentative approval shall not authorize the filing of the plat with the county clerk, the sale of lots in reference thereto, neither of which shall be undertaken until final approval and posting of the guarantees required as a condition to final approval.

ARTICLE XI - UNDUE HARDSHIP

Section 1. These rules, regulations and standards shall be considered the minimum requirements for the protection of the public health, safety and welfare of the citizens of the Township of Medford. Any action taken by the governing body and the planning board under the terms of this ordinance shall give primary consideration to the above mentioned matters and to the welfare of the entire community. However, if the subdivider or his agent can clearly demonstrate that, because of peculiar conditions pertaining to his land, the literal enforcement of one or more of these regulations is impracticable or will exert undue hardship, the planning board and governing body may permit such variances as may be reasonable and within the general purpose and intent of the rules, regulations and standards established by this ordinance.

Section 2. The planning board shall have the authority to employ an attorney of its own choosing to serve at the pleasure of said board as well as a duly licensed and qualified engineer, other experts and a staff also to serve at the pleasure of the planning board, and pay for their services and for such other expenses as may be necessary and proper, not exceeding in all, exclusive of gifts the amount appropriated by the governing body for its use.

Section 3. If any article, section, sub-section, sentence, clause or phrase of this ordinance is for any reason held to be unconstitutional or invalid, such decision shall not affect the remaining portions of this ordinance.

Section 4. All ordinances or parts of ordinances other than the Zoning Ordinance of the Township of Medford which are inconsistent with the provisions of this ordinance are hereby repealed to the extent of such inconsistency.

Section 5. This ordinance shall take effect immediately after final passage and publication according to law.

FOOTNOTES

1. Council on Environmental Quality, *Environmental Impact Statements An Analysis of Six Years' Experience by Seventy Federal Agencies*. Washington, D.C.: CEQ, March 1976.

2. Kaiser, et al., *Promoting Environmental Quality Through Urban Planning and Controls*, Washington Environmental Research Center, EPA, Washington, D.C., 1973/

3. This is also necessary to the HUD Flood Insurance program, so data is likely to be more readily available in the future.

4. This is basically the process used in Medford Township, New Jersey.

5. Many communities in the state of New Jersey, and several in Pennsylvania, have been active in variations of this review process, as has Dallas, Texas.

6. Carter, et al., *Environmental Management and Local Government,* Office of Research and Development, EPA, Washington, D.C., 1974.

   Richard E. Galantowitz, *The Process of Environmental Assessment - Options and Limits*, North Jersey Conservation Foundation, Morristown, New Jersey, Vol. 5, p. 11.

7. The Upper Raritan Watershed Association and the Bedminister Township Environmental Commission have published a highly detailed guidelines for an environmental impact review program, which in our view is too complicated ever to be implemented properly. Overly complex procedures may be worse than none, since they can create a general hostility to all environmental programs. Reference: Ashmun and Larson, *Municipal Land Use Decisions, the Tools and Methods*, December 1974.

8. Bucks County Planning Commission, *Natural Resources Plan, Phase II*, Bucks County Pennsylvania, December 1972.

9. Galantowitz, *op.cit.*

10. *ibid.*; c.f. ASPO, *Performance Controls for Sensitive Lands*, EPA, 1975.

11. Center for Ecological Research in Planning and Design, and the Department of Natural Resources, Commonwealth of Pennsylvania, "Guidelines for Land Resource Inventory and Analysis for Planning," 1975.

12. Often flood "prone" areas are distinguished from usual floodplain areas on the basis of the frequency and severity of flooding. A flood prone area is usually on the "shoulders" of a floodplain--when it floods, the soil may be only under a few inches of water, and this may be rare, such as during a 100 year flood. The distinction is useful for planning purposes, since property damage in a flood prone area may be tolerable for certain land uses, or if certain design and planning precautions are taken.

13. E. Selig, "Regulatory Dimensions on Nonpoint Source Control," Abt Associates, Cambridge, Mass., 1976.

14. Conversation with Gerald Haughey, the attorney who developed Medford's subdivision ordinance. Some town officials are more optimistic, saying costs were fully recovered in less than two years.

15. Conversation with Lane Kendig, Bucks County Planning Commission.

16. Conversation with Ann Morris, New Jersey Association of Conservation Commissions.

17. Conversation with Robert Pearson, Center for Ecological Research, University of Pennsylvania, Philadelphia.

18. Conversation with Gerald Haughey.

APPENDIX I-1

The following pages present a review of various local applications of the police power affecting environmental policy objectives. The aim is not to give a complete analysis of these legal tools, but rather to indicate their potential for making a substantial contribution to environmental programs.

The reader is referred to individual chapters of the report as appropriate. This section of the Appendix should be used as a background for the second section, in which the interactions of individual ordinances and regulations with specific aspects of environmental quality are discussed.

ZONING

General Districting

Mode of Implementation: Agricultural Zoning, Holding Zones, Large Lot Zoning, Open Space Zoning.

Description--
Conventional district zoning may have a limited positive impact on local environmental quality if carefully done. The premise of such districting would be to zone areas for uses which are environmentally compatible. For instance, agricultural zoning is sometimes employed as an open space protection measure or as a holding category pending completion of development in established areas. Similarly, large lot zoning may be undertaken with the same principle in mind: the government may be unwilling to provide water and sewer service and will thus zone for densities which can use groundwater sources and septic tanks. Large lot zoning is sometimes also construed as open space zoning.

General districting is, however, a gross tool for managing environmental quality, and it often has negative results.

Large lot zoning, although it may often be upheld by courts if it is tied to health considerations (such as minimum lot sizes for septic tank use), may in the long run defeat environmental quality objectives. It can aggrevate leapfrogging of development beyond the large lot zones, and ultimately development within the zone will probably have to be serviced with municipal water and sewer facilities, at substantial expense--large lot zoning usually produces scattered upper income units which locate on the most attractive sites in the area. Furthermore, once large lot areas are developed fully, little open space is actually left--each lot is privately held and developed, and the integrity of natural areas is destroyed.

Urban/Rural Context--Large lot and agricultural zones are appropriate only in rural or fringe suburban areas. As indicated above, they may be construed by courts as exclusionary, especially if they lie within major growth corridors.

With the exception of authentic agricultural use districts, conventional district zoning is a weak tool with which to protect environmental quality.

Legal Issues--Courts have frequently overturned agricultural zoning where it is found to be a disguise for open sapce zoning, or a holding category. Successful agricultural districting, such as New York State's agricultural district program set up in 1971, is explicitly planned for farming only in well defined districts with a minimum acreage. The programs include preferential assessment to make farming economically viable, and the farmer should also make a legal commitment to agricultural land use over a specified period (usually eight years) with annual renewal and penalty clauses. It is useful to tie agricultural zones to prime agricultural land, ascertained by a soil survey.

Administrative Issues--No special administrative issues are associated with the attempt to use purely conventional zoning techniques to achieve environmental quality.

Sensitive Area Protection

Mode of Implementation: Wetlands Conversancy Districts, Hillside or Steep Slope Development Regulations, Groundwater Protection Zoning, Stream Bank Protection Ordinances, Woodlands Protection Ordinances.

Description--

A number of zoning approaches comprise the overall category of sensitive area protection.

1. They usually overlay existing zoned use districts, although they may drastically limit otherwise permissible activities.

2. Their environmental benefits are similar, having most to do with local water management problems and wildlife/aesthetics issues.

One of the major forms of sensitive area protection is discussed below. For a full discussion of the subject, see Charles Thurow, William Toner, Duncan Erley, Performance Controls for Sensitive Lands (U.S. Environmental Protection Agency, Washington, D.C. 1975).

Wetlands Conservancy Districts--Wetlands Conservancy Districts are written to encompass most of a community's wetlands. They seek to maintain the ecological integrity of wetlands by restricting development to non-intensive uses and by restricting dredge and fill operations. A permit procedure is set up by which all development activities are reviewed for their environmental impacts.

Legal Issues: Most communities which have instituted wetlands conservancy districts have not had legal problems. The central issue legally is the problem of inverse condemnation--the denial to the landowner of a reasonable return on his land. Courts are becoming increasingly sympathetic to environmental protection ordinances of this type, since valid community objectives are served by wetlands preservation, including such immediate benefits as flood control.

A leading case in the field of wetlands regulation is Just v. Marinette County.* In that instance, the court made the following important point:

> An owner of land has no absolute and unlimited right to change the essential natural character of his land so as to use it for a purpose for which it was unsuited in its natural state and which injures the rights of others. The exercise of the police power in zoning must be reasonable and we think that it is not an unreasonable exercise of the police power to prevent harm to public rights by limiting the use of private property to its natural uses. (emphasis added)

This appears to be a crucial distinction. The court, in effect, is saying that the zoning ordinance protecting wetlands is not depriving an owner of value since there is no value (for development) intrinsic in the land. It is only after the land is filled, i.e., changed to something other than its natural state, that the issue of taking of value can be legitimately raised. Such a distinction cannot be made with other sensitive areas a community wishes to protect--wetlands are the only sensitive areas commonly protected which are unsuited for development in their natural state (see below).

---

*56 Wis. 2d 7, 201 N.W. 2d 761 (1972), 4 ERD 1841.

Administrative Issues: (1) Landowners must initiate application for permits to alter wetlands, and, due to the vagaries involved in mapping wetlands boundaries, may independently decide that their land is unaffected by the ordinance. It is, therefore, preferable, although comparatively costly, for the community to undertake a formal mapping of wetlands within its jurisdiction rather than to define wetlands in descriptive terms in the working of the ordinance.

(2) Mapping of wetlands is not always possible: wetlands may fluctuate from year to year depending on rainfall and other natural and man-made disturbances. Some communities have set up tentative mapping procedures which can be adjusted as more accurate information becomes available, or define wetlands based on the presence of specific plant varieties.

(3) Some of the generally permitted uses may actually cause wetlands damage--farming is the prime example. The use of pesticides and fertilizers associated with many farming activities is generally detrimental to the wetland. This raises the legal issue of taking once again, for wetlands in their natural state are appropriate for certain agricultural uses (e.g., cranberry farming) which are not covered by the wording set forth in Just (discussed above).

Comments: (1) Flexibility can be built into the wetlands ordinances by means of a special use permit, allowing uses with specified environmental performance. This can reduce the taking in most cases. Where a property lies only partly within a wetland, and if environmental circumstances permit, a density bonus for development on the buildable sections of the land may be appropriate. Most communities have also developed special tax and assessment policies for districts affected by wetland regulation to offset the hardship of the limitation on development.

(2) Some means of restricting activities occurring at the boundaries of the wetlands district is necessary to maintain adjacent compatible development. Buffer zones protect wetlands from runoff, sedimentation, biochemical degradation and thermal pollution. Often fixed or variable buffer zones can be established in which environmental controls are exercised over a list of permitted or special uses larger than that permitted within the wetlands district.

(3) The control of wetlands may be ineffectual without considering the natural processes within the watershed. As a watershed becomes more developed, the capacity of the wetland to deal with erosion and runoff is overwhelmed. The design of the wetland regulation should only occur in the context of larger controls over the watershed.

Performance Zones

Mode of Implementation: Effluent Allotment Ordinances.

Description--

Direct regulation of residuals discharge (performance control) is unusual in zones which are not sensitive areas *per se*. The most familiar performance controls in such areas have to do with *noise*, which is essentially an outgrowth of nuisance legislation. Local control over the production of environmental residuals is not extending to both air and water pollution.

Effluent allotment ordinances control effluents from local subdivisions, particularly from "package plants," which are a common source of water pollution. Most water pollution control has been preempted by the state and federal governments in the United States, and is keyed to ambient water quality indirectly through the National Pollution Discharge Elimination System (NPDES), which specifies minimum levels of treatment for all discharges, and requires more stringent treatment for all discharges, and requires more stringent treatment where water quality standards would not be met otherwise. While local communities are not permitted to lower the standards of water treatment provided; they may require more stringent standards to meet special community objectives. Effluent allotment ordinances fulfill this function: where it is felt that local stream quality considerations demand more stringent controls on effluents than federal or state agencies require, higher performance standards may be enacted. Streams with low flow may be protected from all discharges, and other streams may have maximum effluent flows specified at some fraction of total streamflow at any time.

Legal Issues--Effluent allotment ordinances may, in effect, create new performance zones within a municipality--areas in which effluents to streams must follow special standards. The idea of effluent zones has not been widely used in this country because of national policy to clean up all streams and waterways to minimum standards of purity. In Europe, a different policy has been followed--certain streams are designated as pollutable, and have become, in effect, open sewers; other streams have been protected, and effluents which they formerly received are diverted to the pollutable zones.* Effluent allotment ordinances are similar to effluent zones in that they control residual production by districts, but they do not simply shift effluents from one stream to another.

Package plants have been a serious pollution problem in many communities because most of the time they simply do not work up to specifications. The effluent allotment ordinance quoted here explicitly states that standards must be met at all times.

---

*The Euscher River in Germany is a case in point. Some wastes from the Ruhr area are pumped over into its watershed; the river itself has been fully lined with concrete and serves as an open sewer.

Administrative Issues--Actually testing plants to conform with stringent standards is a difficult and expensive task. It is not known how effective these new ordinances will be in actually maintaining higher standards of treatment in local package plants.

Flexible Zoning Alternatives

Mode of Implementation: Planned Unit Developments, Cluster Subdivisions, Regulations and Others.

Description--

It is an old complaint that zoning imposes a sterile monotony on the landscape, and in many communities attempts have been made to make zoning more responsive to the aesthetic needs of the community. Uniformity of lot size, set back, and separation between houses has been relaxed under special zoning amendments to allow more rein to the designer's imagination in siting and design. Going a step further is the concept of relaxing restrictions on uniform activities within a development, allowing necessary support facilities to be included within the subdivision development.

The two main tools in achieving these ends have been Planned Unit Developments, which allow flexibility in siting and design as well as a mix of uses on site, and cluster development, which merely varies the siting requirements of housing in conventional residential districts. Both of these tools have environmental quality implications that may be as important as their aesthetic and practical value.

The immediate reasons for implementing clustering and PUD ordinances are mainly aesthetic; their environmental benefits are scarcely discussed in the literature, though in the past two years, more interest has appeared. Fortunately, aesthetic and environmental goals are closely similar when it comes to preservation of open space, where the principal advantage of both PUDs and clustering options lie. In general, the only modification of clustering and PUD ordinances necessary to optimize their environmental benefits is to key site planning to the preservation of environmentally sensitive areas, which are possibly distinct from the most aesthetically valuable areas.

Terminology--

There is a good deal of confusion in the terms used to describe various flexible design alternatives. Planned Unit Developments are sometimes called "planned unit residential developments," "design integrated development districts," "planned cluster developments," and even "cluster development." In general a PUD is any development composed of separate elements that has been designed from the beginning as a unit. It may include entire new towns, such as Reston, Virginia, or may apply to a shopping center, industrial park, or commercial district.

Cluster subdivisions may also be called "cluster development," "cluster zoning," "open space developments," or the like, but they are purely residential in character. On a given tract, instead of dividing the land into conventional sized lots, houses are located on lots of reduced dimensions and the balance of the land is left open. In order to maintain the overall density limitations of the zoning district, the open land is legally reserved in some form of ownership or easement so that it can never be developed.

In practice, PUDs and cluster subdivisions in suburban areas are similar in appearance, the PUDs also holding a significant portion of their land open in perpetuity. This accounts for much of the confusion in terminology.

Legal options for holding the open land in cluster subdivisions include:

- Holding the land in nonprofit ownership for the use of the subdivision residents alone.
- Dedication of the land to the community for use as parks, open space, or playgrounds.
- Donation of the land to a conservation commission, water department, or other public body which maintains it in its original ecological condition.
- Easements on the land which permanently restricts its development rights, whoever the owner is.

Significantly, both cluster subdivisions and PUDs are optional to the developer. In Chrinko v. South Brunswich, N.J., 1963, it was established that the optional feature of cluster zoning makes it available to all developers and thus a uniform regulation throughout a residential district. Being optional, they may often be underutilized. Many benefits are claimed for flexible zoning and subdivisions--for the developer, they may lower construction costs; for buyers they supposedly bring lower maintenance costs and a better natural atmosphere. In practice, however, many communities, developers and buyers are still wary of variations on the conventional development scheme.* Increased amounts of planning time are required to put these options into effect, and as a result it is probably necessary to include bonus density provisions for developers who adopt the PUD or cluster subdivision options.

Legal Issues--

Planned Unit Developments require state enabling legislation, but this is now available almost everywhere. Cluster subdivisions may be undertaken at local initiative, and are legally simple to implement. The optional feature of both approaches appears to be legally necessary safety valve.

In some states, PUDs may come close to being "contract zoning," zoning that is so drawn as to meet the situation of a particular developer. While the terms of a PUD are meant to be flexible, they are being revised toward a more limited density and conventional layouts in some states to prevent them from being a back-door method for developers to avoid zoning restrictions altogether, and to allay public fears of same.

---

*In one study (Lansing, Marans, & Zehner, Planned Residential Environments, Ann Arbor, Michigan, Institute for Social Research, University of Michigan, 1970.), it was found that many families prefer privately accessible open space to publically provided "green belts," though it is possible that all requirements may be met by sensitive architectural and landscape design.

To a great extent, public wariness of PUDs has tended to undermine their potential. Originally, it was hoped by some that PUDs would enable towns to escape zoning altogether, and negotiate development on a case by case basis in a manner which would result in a superior product for community, developer, and consumer. This is not happening, for any number of reasons. One of the most important is that towns may decide to permit PUDs in practice, and then object to the specific case. Insofar as PUDs are potentially floating zones--not specifically located on the zoning map until they are privately proposed--what seems like a good idea in principle may be a bad idea in practice when it is built next door. The suburbs appear to be retaining a highly conservative stance on most flexible zoning alternatives.

Administrative Issues--

Administration of flexible zoning alternatives is definitely more expensive than conventional subdivision approval processes, in that both town and developer are obligated to address specific issues and facts when siting and designing the project. In the long term, these administrative costs can be a good investment for all concerned, as the more sensitively designed projects can result in lower public, private, and environmental costs. However, since developers inevitably focus on short-term returns, bonus and incentive plans must often be adopted to encourage private participation in flexible zoning alternatives.

Comments--

Most of the difficulties in implementing flexible zoning alternatives are social and financial in origin. The controversy which still surrounds these techniques tends to eclipse the importance of their environmental benefits, which can be highly significant. It seems likely that to reduce public contention, future applications of flexible zoning alternatives will tend towards the conservative side, and departures from the conventional suburban housing format will be minor. While major environmental benefits may still accrue through the use of these tools--particularly in the preservation of open space and protection of environmentally sensitive areas--some of their potential is likely to be foregone for the present.

A number of other zoning tools are often mentioned as having environmental benefits. In practice, they are not markedly different in environmental effect from those we have discussed above. They are discussed briefly below.

Conditional Zoning--Conditional zoning is a method of rezoning whereby an applicant agrees to abide by specific conditions before zoning, usually to a higher use. The purpose of conditional zoning is to assure more specific control over zoning and it sometimes is called "site plan zoning." Often a developer will be required to submit specific site plans showing the exact characteristics of his proposed development. He will be required to adhere to his site plan before rezoning is granted. This gives the community an opportunity to consider in detail a rezoning to a zoning category which may permit a variety of uses or developments which are undesirable. Conditional zoning is often used for commercial rezoning where the community wishes not to over-zone but finds a particular use with conditions established beforehand serves a surrounding neighborhood. There is a fine line between conditional zoning and contract zoning. Conditional zoning also assures that a developer will abide by the timing of development he proposes (i.e., that he will not delay in the use of his new development right).

Floating Zones--We have discussed PUD as a potential floating zone. That is, specific locations have not been determined ahead of time for the district although certain minimal criteria (e.g., minimum lot size) must be met before an applicant can utilize this procedure. In some states, floating zones are illegal--considered "spot zoning." Wetlands conservancy districts which are not mapped can be floating zones. A definitional approach is used to identify potential wetlands areas where controls may be applicable. A transit-impact zone without specific boundaries (because transit stations have not been finely established) is another form of floating zone.

Incentive Zoning (bonus zoning)--Incentive zoning refers to the practice of building incentive provisions into the zoning ordinance so that the developer will take advantage of certain techniques or provide certain amenities. Tradeoffs are often made within a given development. For example, a developer is permitted a higher density in return for stricter development standards such as enclosed parking or plazas or developed open space. In a broader sense, incentives may be built into the ordinance so that developers will take advantage of certain techniques such as permitting a slightly higher density for a subdivision if the developer choses PUD rather than traditional developement.

Transitional Zones--Transitional zones are often used to protect low density residential uses from adjacent commercial uses or high density residential uses. An example of a transitional zone is an Office Conversion District, where single family homes abutting a commercial district may be converted to office or institutional use if their exterior is maintained.

SUBDIVISION REGULATIONS

Sanitary Sewage Requirements

Mode of Implementation: Subdivision Regulations (Health Code Enforcement), or Municipal Ordinance (Septic Tank Ordinance).

See Chapter IV.

Stormwater Management

Mode of Implementation: Subdivision Control Ordinance.

See Chapter V.

Street Design

Mode of Implementation: Subdivision Ordinance

Description--

The layout of streets in subdivisions must conform to certain standards of design, usually laid down in a public facilities manual which incorporates general subdivision regulations. Although little has been done with this tool to improve environmental quality, it is possible that sensitive street layouts can aid environmental objectives by reducing automobile trip lengths to local destinations, and perhaps by functioning as emergency stormsewer overflow channels (e.g., by inverting the crown) where heavy rains are common. Layouts and designs might also be coordinated with water and sewer planning to lower the penalty costs of future expansion of these utilities, and might thus reduce the costs of implementing phased capital facilities programs to achieve environmental quality and control community growth.

Legal Issues--The control of streets design by subdivision regulations generally raises no legal problems.

Administrative Issues--Revision of standards for street designs would probably entail little if any additional administrative obligation or expense if appropriate model ordinances were enacted.

Environmental Impact Statements

Mode of Implementation: Subdivision Regulation.

See Chapter VIII.

ACQUISITION

Less-Than-Fee Acquisition

Mode of Implementation: Eminent Domain, if necessary.

Description--

Less than fee land acquisition implies the purchase, or if necessary, the condemnation, of rights to land which amounts to less than the fee simple value. the principle is well established in law that easements and covenents are proper means of limiting and controlling land uses. Most commonly, easements are purchased to permit permanent or limited rights-of-way across property, such as for roads, local utilities, gas and oil pipelines, and high-tension wires.

Applying less-than-fee acquisition of land rights is now sometimes used by conservation commissions for preserving natural areas for wildlife or bird sanctuaries, marshland preservation, and the like. In effect, such easements amount to a purchase of all or most of the development rights to a property; the acquisition of development rights exchanges the property owner's right to develop or change the use intensity of his land for the full compensation of that interest or right. For example, if a farm was worth X dollars as farm land and Y dollars if developable under the zoning or other regulation in effect, the airport would purchase or condemn the development right by paying Y-X dollars.

The term of such an acquisition is usually about twenty-five to thirty years for a conservation easement, and may be permanent in the case of the sale of developable rights. The prospects of selling permanent development rights to a property naturally causes the price to rise, often practially to the full market value of the land. Indications are, however, that in areas with moderate land speculation, the prices paid for such easements are, in fact, higher than they are worth.* Owners overestimate their property's value--in essence minimizing the perception of risk. Land prices actually may rise because of the easement since the natural amenities of the area are not protected and values stabilized.

---

*This was found to be the case in a recent program intended to protect the Brandywine River in Pennsylvania--attempts to purchase easements were unsuccessful, even when as much as 50% of the land's value was offered. Owners instead asked for condemnation proceedings to take their land in fee simple.

Legal Issues--One legal issue which is of prime concern to the success of easement programs if preferential assessment of property whose development rights have been limited to a significant extent. Preferential assessment programs in some states have been purely voluntary on the part of land owners, and have not involved the use of easements.

Land Banking

Mode of Implementation: Eminent Domain

Description--

Since no method of land use control is as effective as outright ownership, land banking * is increasing in importance nationally on all levels of government.

---

*Land banking is usually defined as acquisition to full title to land, but easements for conservation or environmental protection purposes are also landbanking in a practical sense. Various less-than-fee-simple purchase options are also available to communities to achieve the same results as immediate cash purchase, including ultimate possession of title to fee-simple. They are:

Remainder Interest: The purchase or condemnation of a remainder interest gives the purchaser title to the fee-simple after a specified number of years. The value of the remainder interest is equal to the present fair market value less the value of the use of the land over the intervening years. Over a medium term (ten to fifteen years), this may represent a savings--over the long term it might be cheaper to pay the entire fee immediately. Of course, while the land remains in private hands and continues to generate tax revenue over the interim, there is no guarantee as to its interim use. It is assumed, however, that the land would not be developed, since all improvements would become the property of the purchaser without additional payment. This alternative is probably inappropriate for protection of sensitive lands.

Option Purchase: An option may be purchased or condemned to buy land at its present market value at a specified future date, the option value being the estimated appreciation of the land in that time, discounted to the present and calculated in present dollars. Meanwhile the land remains in private hands. Since the land may be developed in the interim, option purchase may be inappropriate for the protection of sensitive lands. Also, calculating the option value is something of a gamble.

Installment Purchase is possibly the most favorable option to the seller for tax purposes, but has the disadvantage that in most states it cannot legally be used for land acquired by condemnation. Payment for the land is simply distributed over a specified time period in exchange for an increased total price. Installment purchase may be a reasonable way to acquire larger tracts of land for conservation purposes in communities without heavy development pressure, and where the town can cooperate with present owners to further conservation objectives.

A land banking program should assume the use of the fee-simple purchase, but should also allow the use of these less familiar techniques where appropriate.

It has been used or suggested as a useful adjunct to

- urban renewal
- highway development
- provision of low- or moderate-income housing
- industrial development
- advance land acquisition for public facilities
- urban growth control strategies
- open space acquisition
- sensitive area protection.

The use of land banking to improve or protect environmental quality is covered by the last four options. An examination of its role in general urban growth control strategies is beyond the scope of this study, however. We are more concerned with land banking as a means of advance site acquisition for public facilities, and its use in open space and sensitive area protection.

Advance acquisition of public facility sites is the most widespread application of the concept. The most recent study of advance land acquisition by local governments was conducted in 1966. A HUD-sponsored study found that about one-third of the cities with populations of over 50,000 had land banking programs (defined as acquisition of land three years or more in advance), though county-operated programs were found to be uncommon. The objects of these programs were most frequently to acquire sites for schools, parks, fire stations and other government buildings. The term of such land banking ranges from about two to ten years, and sites average only a few acres.

Larger scale land banking has often been undertaken by state highway departments to minimize acquisition costs--land is often over a third of total project costs. Since 1968, the Federal Highway Administration has conducted an active landbanking program involving a revolving fund for interest-free loans. Airports also bank land, for use in future expansions and as noise buffer zones; water companies use the process to acquire and protect watersheds. Up to 10,000 acres are sometimes banked and the land is held from as little as two to five years in the case of highways to as long as ten to twenty years for airports, and permanently for watershed.

The difficulty with land banking for environmental protection is that it is a last resort, turned to when regultations such as zoning and subdivision control are found to be unreasonable restrictions on a landowner's rights to beneficial use of his land. Condemning easements on limited development rights is theoretically a cheaper way to achieve the same purpose, but in many rapidly growing areas, where land speculation is intense, the cost of an easement may amount to a substantial fraction of the entire value of the land, and the owner may demand a taking in fee.*

Legal Issues--Landbanking is necessarily founded on the sovereign power of the state of eminent domain, a power which is implicit in both state and federal constitutions. Constitutional provisions merely limit and define a power which is otherwise limitless. State courts agree that land taken by eminent domain must be for a "public use," and the fifth amendment states "nor shall private property be taken for public use without just compensation."

The concept of public use is more closely defined by settled practices and social necessities of the people of the state in which the question arises than by philological considerations. In essence, the concept of valid public use can change, and it is now changing toward an interpretation which allows land to be acquired well in advance of use, and even without intent to develop it.

In the only major case on landbanking in the United States, the Commonwealth of Puerto Rico v. Rosso, the use of eminent domain in land banking was strongly upheld. Rosso, whose land had been condemned by the Puerto Rico Land Administration, argued that "...the public use doctrine--under both the United States and Puerto Rican Constitution--prohibited the Commonwealth from condemning private property until there was a specific plan for the land and a clear public necessity for doing so." The Supreme Court of Puerto Rico rules against Rosso, saying the taking was a "legitimate use of the police power in protection of that which a community of 2,712,808 human beings existed in a territory of 3,435 square miles sees as a most precious value for survival: vital space."

---

*Beginning in 1962, Bucks County, Pennsylvania, launched a comprehensive program to protect and enhance the water resources of the Neshaming Creek involved acquisition of both flooding and conservation easements from a large number of owners. When the landowners refused to sell easements, the county moved to condemn the property in fee. The conservation easements sought to regulate agricultural uses of land, limit erosion to three tons per acre per year, keep all land under vegetative cover, and limit impervious cover to 15%, and owners were initially offered three to four percent of the value of the whole parcel. In many cases, owners insisted that the land be condemned for a fee taking, even if as much as ten percent of the land value were offered for the easement. This is probably due to the owners' perception of the immediate drop in the value of the land which would probably be significantly more than the long term loss. Nevertheless, conservation easements averaged ten to fifteen percent of land values, flooding easements (with more drastic restrictions of land uses) about 50% of land values. Strong & Keene, Environmental Protection through Public and Private Development Controls, EPA, Washington, D.C., May 1973.

the relevance of this decision to conditions on the continental United States, where space is certainly not at such a premium as in Puerto Rico, may be challenged, but it seems probable that landbanking for public purposes, including preservation of open space and sensitive areas, will not be challenged as exceeding the constitutional bounds of eminent domain.

Administrative Issues--The administrative issues of landbanking are complex whenever a major project is undertaken. Full treatments of landbanking mechanics and financing are readily available from a number of sources, some of which are listed below under REFERENCES.

Undeniably, landbanking is an expensive way to achieve environmental objectives such as preserving open space or sensitive areas. The costs of achieving the objectives may be lowered substantially, however, by reselling the land for development with a variety of necessary restrictions on its use written permanently into the deed. If the restrictions are written as leniently as possible while still consistent with the environmental objectives of the project, the resale value will be maximized.

Where landbanking is used in its most common form to acquire a site for a necessary facility such as a sanitary landfill, significant cost savings are involved. Since the optimum sites for public projects are usually optimum for private development as well, advance acquisition can yield major savings over the short and medium term, depending on the appropriate rate of discount and the pressure of land speculation in the community.

CODES

Construction Codes
Building Codes
Health Codes

Mode of Implementation: Codes (See also Chapters III and IV).

Description--

Three groups of codes have impacts on local environmental quality. Present codes often integrate all three together, or make some other, equally artificial, division. Codes, however, have three basic environmental functions:

- They control the impacts of construction;
- They influence the design of buildings; and
- They insure the building is maintained and continues to meet standards.

All of these functions are included in present codes, and the best place to include modifications will vary from community to community.

Construction Codes (11) cover control of the short-term but often large impacts of construction, such as erosion of the bare site, equipment noise, and sanitation for the workers.

Building Codes (12) are concerned only with building design and materials. Plumbing codes and insulation standards are important examples.

Health Codes (13) are the third stage. New buildings can be designed to meet standards, but too little upkeep can lead to major environmental problems, particularly for solid wastes and heating. As standards change, previously good designs may become unacceptable (for example, small apartment incinerators). The health codes are used to ensure that standards are met, so that the building remains fit for use.

All three parts of the problem are important. Construction impacts are temporary, but "temporary" soil loss in developing areas can lead to sedimentation, poor drainage, and expensive dredging or other repairs. Without good design caused by building codes, builders may use cheaper methods, resulting in buildings with low first cost but large environmental impacts and even hazards to residents. However, the codes must also provide for continuing use and inspections to insure that the garbage is collected, the windows are not broken, the heat works, etc. Protecting the residents and the environment in this way is the role of health codes.

Legal Issues--The community has the right to protect its inhabitants. It has the right to set standards for buildings to do this, as long as the standards are based on good reasons. Construction codes look at the impacts of construction on the community: noise, traffic congestion, soil loss, and other problems. Since being able to build at all is a privilege, controls on construction are a reasonable use of the police power. Building and health codes are similarly important to protect the public, and building and occupancy permits can be revoked if necessary by the community.

Administrative Issues--Code inspection can either be regular or on complaint. In most areas, design and construction are inspected for each building, and health code inspections are made when people complain. A few communities are requiring regular health code inspections, with a new Certificate of Occupancy at each change of title or occupant.* Some special hazards are regularly inspected for maintenance, such as elevators; others, such as package sewage treatment plants, should be. The problem with inspecting only on complaints is that people may accept below-standard buildings without complaining, particularly if the impacts are off-site.

---

*For example, Pasadena, California, requires occupancy inspection.

REGULATIONS/ORDINANCES

Flood Control Ordinances

Mode of Implementation: Amendment or supplement to existing Subdivision Ordinances, Zoning Ordinances, Building Ordinances, and related ordinances related to drainage.

Description--

Flood control is enacted to minimize or prevent damage to property and to protect public safety. Whereas the other programs examined here are enacted to protect the environment from development, flood control tries the reverse--protecting development from the environment. It is a central concern of local environmental management in areas vulnerable to flood.

Recently, under regulation promulgated by the Department of Housing and Urban Development under the National Flood Insurance Act, local flood control planning is becoming increasingly crucial to community development.* Communities must demonstrate that they have undertaken comprehensive flood plain management programs in order to be eligible for federally assisted flood insurance, and federally insured banks will not be permitted to issue mortgage money to housing built in flood hazard areas. The impact of this program nationwide will be to prohibit intensive urbanization of flood plains and the amortize existing incompatible uses wherever possible.

---

*Section 136A of the Housing and Urban Development Act of 1974 contains the relevant clauses, in amendment to Title XIII of the HUD Act of 1968, the National Flood Insurance Act of 1968:

> "Notice of Flood Hazards"
>
> "Sec. 1364. Each Federal instrumentality responsible for the supervision, approval, regulation, or insuring of banks, savings and loan associations, or similar institutions shall by regulation require such institutions, as a condition of making, increasing, extending, or renewing (after the expiration of thirty days following the date of the enactment of this section) any loan secured by improved real estate or a mobile home located or to be located in an area that has been identified by the Secretary under this title or Public Law 93-234 as an area having special flood hazards, to notify the purchaser or lessee (or obtain satisfactory assurances that the seller or lessor has notified the purchaser or lessee) of such special flood hazards, in writing, a reasonable period in advance of the signing of the purchase agreement, lease, or other documents involved in the transaction."

Flood plains are attractive building sites. They are flat, have fertile soil, and are easy to build on. In previous years, extensive flood control dams and levees have often been build to permit flood plain development or protect unwisely planned projects from further flood damage. Not only are such projects expensive, they are often injurious to local hydrology, reducing downstream flow, increasing upstream sedimentation, and disrupting river basin ecologies in both directions.

Current practices for flood control commonly follow a two-prong approach of (1) limiting runoff from development as much as possible to the pre-development, "natural" level, and (2) preventing incompatible land uses from being established in the flood plain.

The first approach has been covered under Runoff Control Ordinances, Sedimentation and Erosion Control Ordinances, and Building Codes. This section will concentrate on defining and controlling compatible land uses within the flood plain.

Since the HUD Act refers to the 100 year flood plain, flood plain planning is now oriented to that future. The one-hundred year flood plain is that area which will be inundated, on average, no more than once every one-hundred years--

---

*(continued)

> "(e) Notwithstanding any other provision of law, any community that has made adequate progress, acceptable to the Secretary, on the construction of a flood protection system which will afford flood protection for the one-hundred year frequency flood as determined by the Secretary, shall be eligible for flood insurance under this title (if and to the extent it is eligible for such insurance under the other provisions of this title) at premium rates not exceeding those which would be applicable under this section if such flood protection system had been completed. The Secretary shall find that adequate progress on the construction of a flood protection system as required herein has been only if (1) 100 percent of the project cost of the system has been authorized, (2) at least 60 percent of the project cost of the system has been appropriated, (3) at least 50 percent of the project cost of the system has been expended, and (4) the system is at least 50 percent completed."

Regulations have concentrated attention on controlling flood plain land use rather than on dams and other capital projects.

As of July 1, 1975, communities in designated flood hazard areas which do not have a flood plain management plan are not eligible for any form of federally-related financial assistance for acquisition or construction of structures in a flood hazard area.

i.e., that area which faces a one percent chance of flooding every year. The shape of this flood plain depends on climate, topography, soils, local hydrology, and existing and future urbanization. New development which increases runoff from its site over pre-existing levels tends to increase the size of the flood plain.

The following land uses may be permitted in a flood plain without a permit if there is no conflict with other environmental considerations.*

- Agriculture
- Loading areas, parking lots, airport runways, and other non-structural industrial/commercial uses
- Private and public recreation
- Gardens, play areas, and other non-structural residential uses

Other uses should be contingent on a permit, and may include:

- Uses or structures accessory to other permitted uses
- Transient amusement enterprises
- Drive-in theatres, signs, billboards
- Sand, gravel extraction
- Marinas, water-related uses
- Streets, right-of-ways, bridges, overhead lines
- Storage yards
- Structures supported on stilts above the 100-year flood level
- Dams and drainage structures

Legal Issues--Inverse condemnation has been the main legal obstacle to flood plain management; courts may rule than an ordinance is so severe as to deprive a property owner of any reasonable beneficial use of his land, and find it, therefore, unconstitutional. However, courts do rule quite closely on the facts of each case where taking is indeed found. In general, flood plain zoning has been sustained, courts finding that the protection of the public health, safety, and welfare take precedence over the burden to individual landowners.*

---

*Agricultural uses ought to be carefully evaluated to see if they might tend to eutrophy streams through increased sedimentation and additions of chemical nutrients.

Administrative Issues--Towns are now virtually compelled to set up flood plain protection programs. Administrative issues of the new program are not yet clear.

Sanitation Ordinance

Mode of Implementation: Separate Municipal Ordinance; some state preemption.

See Chapter VII.

Tree Ordinance

Mode of Implementation: Separate Municipal Ordinance, also may be incorporated into zoning, subdivision controls.

Description--

Tree protection and landscaping ordinances are enacted as separate ordinances, and may apply to all trees within a municipality. Usually, however, they are designed to protect and care for mature trees of native species along public rights-of-way and on private property. They may also protect particular valuable specimens of trees for historical or aesthetic reasons. They do not protect forest lands *per se* as sensitive areas.**

Generally, tree or landscape ordinances prohibit the cutting of any tree over a certain size, usually abou4 4" diameter at breast height, without a special

---

**City of Welch v. Mitchell*, 121 SE 165 (W.Va. 1924); *American Land Co. v. Keene*, 41 F2d 484,(1st Cir., 1930); *McCarthy v. City of Manhattan Beach*, 41 Cal. 2nd 879, 264 P2d 932 (1953); *Vartelas v. Water Resources Commission*, 146 Conn. 650, 153 A2d 822 (1959); *Speigle v. Beach Haven*, 46 N.J.479, 218 A2d 129 (1966); *Turnpike Realty Co. v. Town of Dedham* 284 N.E. 2d 891 (1972).

** Tree and landscaping ordinances do not protect the important understory of shrubs, herbs, and tree litter and debris which are important in forest ecology and help moderate runoff and erosion. Such concern may be written into an ordinance such as it has been in Hayward, California, (see Addendum I), but this may increase administration costs.

permit. Some ordinances specify different minimum diameters according to whether the tree is a hardwood, softwood, or decorative species. Some ordinances require the planting of trees where deemed necessary to maintain a specified number of trees per acre, prior to subdivision approval.

Legal Issues--No one ever challenges tree ordinances, yet their legal standing may, in fact, be questionable: they infringe on property rights for what is basically an aesthetic purpose. Environmentally related statements of purpose are a recent innovation, and are often tenuous in fact, but do tend to tie the ordinance to factors with a direct effect on the health, safety, and welfare of community residents. This is probably unnecessary from a practical standpoint, since the ordinance's effect of neighborhood property values makes them popular anyway.

Alternative implementation of tree protection is possible through zoning ordinances and subdivision regulations.

Administrative Issues--Administration of special tree protection ordinances may be discharged by a building inspector, a parks division, a city engineering department, a planning board, a town forester, an environmental administrator, etc.

Burning Ordinance

Mode of Implementation: Either as part of air pollution regulation, as a separate ordinance, or with fire codes on sanitary ordinances. Usually involves a permit requirement from the fire department.

See Chapter VII.

Parking Ordinances

Mode of Implementation: Separate ordinance for health and safety.

See Chapter II.

Noise Control Ordinances

Mode of Implementation: Separate Municipal Ordinance

See Chapter VI.

Erosion and Sedimentation Control Ordinance

Mode of Implementation: Separate Municipal Ordinance (also may be implemented through amendments to zoning or subdivision ordinances).

See Chapter V.

Runoff Control Ordinances/Regulations

Mode of Implementation: Separate Municipal Ordinance (may also be incorporated into subdivision or zoning ordinances)

See Chapter V.

REFERENCES

American Standards Association. National Plumbing Code. New York: The American Society of Mechanical Engineers and the American Public Health Association, 1955.

Bryant, William R. "Adapting the Agricultural District Concept to Virginia." In Land-Use Issues. Proceedings of a Conference, Extension Division, Virginia Polytechnic Institute and State University, and Virginia Water Resources Research Center, November, 1974.

Burchell, Robert (ed.). Frontiers of Planned Unit Development, A Synthesis of Expert Opinion. New Brunswick, New Jersey: The Center for Urban Policy Research, Rutgers University, 1973.

Callies. "Commonwealth of Puerto Rico v. Rosso: Landbanking and the Expanded Concept of Public Use." 2 Prospectus 199, (1968).

Carter, et al. Environmental Management and Local Government. Prepared for the U.S. Environmental Protection Agency, 1973.

Crawford, F. "Model Ordinance for Effluent Allotment." Chester County, Pennsylvania.

Flechner, Harvey L. Land Banking in the Control of Urban Development. New York: Praeger Publishers, 1973.

Iowa Water Resources Research Institute. Flood Plain Management and Implementation Strategies for FPM Programs. Iowa State University, December 1974.

Kaiser, et al. Promoting Environmental Quality through Urban Planning and Controls. Prepared for the Environmental Protection Agency. North Carolina University, June 1973.

Kamm, Sylvan. "The Realities of Large Scale Public Land Banking." In Id., Volume III: p. 86.

Kulmala, Katherine. Cluster Zoning in Massachusetts. Cambridge, MA: The Planning Services Group, 1970.

Lewin, S. Law and the Municipal Ecology. Washington, D.C.: NIMLO, 1971.

Massachusetts Association of Conservation Commissions. Massachusetts Conservation Commission Handbook. Boston, MA, 1973.

Nichols, P. The Law of Eminent Domain. 2nd ed., 1917. Discussed in Fishman. "Public Land Banking: Examination of a Management Technique." In Management and Control of Growth. The Urban Institute, 1975.

Puerto Rico v. Rosso. Civil No. E-63-1652 (P.R. Super. Ct. 1964).

Scott, Randall (ed.). Management and Control of Growth. Washington, D.C.: The Urban Land Institute, 1975.

Shoup, Donald, and Ruth P. Mack. Advance Land Acquisition by Local Governments. Washington, D.C.: U.S. Department of Housing and Urban Development, 1968.

Strong, A. and John Keene. Environmental Protection through Public and Private Development Controls. Prepared for the U.S. Environmental Protection Agency. University of Pennsylvania, May 1973.

Thurow, C.; W. Toner; and D. Erley. Performance Controls for Sensitive Lands: A Practical Guide for Local Administrators. Washington, D.C.: U.S. Environmental Protection Agency, Washington Environmental Research Center, March 1975.

Urban Systems Research & Engineering, Inc. Buy Now, Fly Later: Landbanking for Airport Development. Prepared for the Federal Aviation Administration, Department of Transportation. Washington, D.C., 1975.

APPENDIX I-2

The table on the following page is a notated version of Table 1, which appears in Chapter I of the report. The shaded areas have been assigned code numbers that refer to the content of this section of the Appendix. Where a direct relationship exists between a particular legal tool and some factor of enviornmental quality, a code heading is present. Where an indirect or conditional relationship exists between the two, the code appears in parentheses. Discussions of particular interactions are given under the various code headings, but each entry also has a descriptive title. For example, "A.1 THE AIR POLLUTION IMPACTS OF GENERAL DISTRICT ZONING" discusses those interactions between legal tool A, general district zoning, and enrironmental factor 1, air pollution.

A.1 THE AIR POLLUTION IMPACTS OF GENERAL DISTRICT ZONING

The use of large lot zoning, agricultural zoning, and various holding zones to preserve open space and lower overall community densities will tend to reduce the density of area source emissions, which are primarily due to household space heating. This will lead to improved ambient air quality (primarily lower levels of sulfur dioxide and suspended particulates) in regions where background concentrations of pollutants are low, due to the dispersion of sources.

By lowering zoning densities, a smaller number of housing units are emitting pollutants within a given district. If, however, the same total number of units is to be built, and the choice is between spreading them out in large lot zones or clustering them in higher density areas with open space between, the impact on air quality is less clear (see A.4). If zoning densities are increased and total population within the town is also increased over the levels associated with low density, large lot zoning, then emissions due to space hearing will increase and ambient air quality will deteriorate.

The interaction of housing densities and automobile emissions (carbon monoxide, hydro-carbons and oxides of nitrogen) must also be considered. While spacing housing out will tend to disperse air pollutants emitted by furnaces, more automobile travel is necessary. However, in the densities associated with suburbs today, it is likely that the low density option will yield higher ambient air quality locally than higher densities--automobile emissions themselves may become sufficiently spread out to yield net ambient quality improvements overall.

References:

--Real Estate Research Corporation. The Costs of Sprawl. prepared for CEQ, EPA, HUD, April 1974.

--Hagevik, G.; D. Mandelker; & R. Brail. The Contribution of Urban Planning to Air Quality. EPA, February 1974.

Table A-1: Applications of the Police Power to Improve Environmental Quality

			ZONING				SUBDIVISION REGULATIONS				ACQUISITION (Eminent Domain)	
			General Districts Lot Specs 1	Sensitive Areas 2	Performance Zones 3	Flexible Zoning 4	Water & Sewer 5	Stormwater Management 6	Streets 7	EIS 8	Less-than Fee 9	Land-Banking 10
AIR POLLUTION	Non-Point	A	A.1	A.2		A.4	A.5			A.8	(A.2)	(A.2)
	Mobile	B	B.1 (B.4)	B.2 (B.17)		B.4			B.7 (B.4)	(A.8)		
	Point	C								(A.8)		
WATER QUALITY	Non-Point	D	D.1	D.2 (D.21,D.22)		(G.4)	D.5	D.6 (D.20,D.21)		(A.8)	(D.2)	(D.2)
	Point	E	(F.1)		E.3 (G.3)		E.5	E.6		(A.8)		
	Groundwater	F	F.1	(H.2)			F.5	F.6 (F.21)		(A.8)	(G.2)	(G.2)
WATER QUANTITY	Flooding	G	(D.1)	G.2	G.3		(G.3)	G.6		(A.8)	(G.2)	(G.2)
	Supply	H	(D.1)	H.2			H.5			(A.8)	(H.2)	H.10 (H.2)
SOLID WASTE		I	(I.4)			I.4				(A.8)		I.10
NOISE		J	(J.19)	(J.19)		(J.19)				(A.8)	(J.19)	
OTHER	Toxic Substances	K					K.5			(A.8)		
	Energy: Transportation	L	M.1 (B.1)			L.4				(A.8)		
	Energy: Buildings	M				M.4				(A.8)		
	Soils	N								(A.8)		

(continued on following page)

Table A-1 (continued)

			CODES			REGULATIONS/ORDINANCES							
			Construction 11	Building 12	Health 13	Flood 14	Sanitation 15	Tree 16	Burning 17	Parking 18	Noise 19	Erosion/ Sedimentation 20	Runoff 21
AIR POLLUTION	Non-point	A		A.12					A.17			(A.20)	
	Mobile	B						B.16 (A.3)		(B.18)			
	Point	C											
WATER QUALITY	Non-Point	D		(D.5)		(D.21)	(F.15)			D.18		D.20	D.21
	Point	E											
	Groundwater	F		(D.5)		(F.6)				(H.21)			(H.21)
WATER QUANTITY	Flooding	G		G.12 (G.21)		G.14 (G.21,K.2)		G.16				G.20	G.21
	Supply	H			(E.13)	(H.6)						H.20	H.21
SOLID WASTE		I	I.11	I.12	Section VI		Section VII		(I.4)				
NOISE		J	Section VI	Section VI	Section VI		J.15	J.16		Section II	J.19		
OTHER	Toxic Substances	K		K.12	(K.12)	K.14	K.15						
	Energy: Transportation	L								Section II			
	Energy: Buildings	M		(A.12) (H.12)	M.13								
	Soils	N	N.11									N.20	

A.2 THE AIR POLLUTION IMPACTS OF SENSITIVE AREA ZONING

The protection of sensitive areas provides open space which can theoretically serve a community as air pollution buffers and sinks. The distance which such buffer zones place between a source and a receptor serves to disperse pollutants. The intervening vegetation of a buffer zone can serve as a filtering device, and to a limited and as yet an unquantified extent, it can lower local concentrations of pollutants by absorption. Trees remove some aerosol (particulate) and gaseous pollutants through their leaves, and coniferous species are found to be the most efficient in doing so. Air pollutants also injure vegetation in high concentrations, a factor which mitigates total effectiveness of a buffer. Probably the most effective pollution reduction by trees is of ozone, dust particulates, and solid and gaseous radioactive substances. Taking the dispersion and absorption effects together, buffer zones such as protected woodlands and wetlands can improve ambient air quality in comparatively low density areas (suburbs, rural areas), but in those cases, total pollution concentrations are fairly low anyway.

Site-specific conditions of various geographic locations and pollution problems makes specific recommendations on the use of buffer zones impossible, however.

References:

--Hagevik, et al. op.cit.

--Thurow, D.; W. Toner; & D. Erley. Performance Controls for Sensitive Lands. Washington Environmental Research Center, U.S. Environmental Protection Agency, Washington, D.C., March 1975.

A.4 THE AIR POLLUTION IMPACTS OF FLEXIBLE ZONING MEASURES

The clustering of single family units in subdivisions probably has no effect on ambient air quality as it is affected by residential space heating requirements. The immediate concentrations of air pollutants would theoretically be marginally higher in the housing area itself, since they would be located on smaller lots and be closer together, but the clustering allows undeveloped open space to serve as a buffer between subdivisions, tending to disperse air pollutants. Gross densities and gross emissions are unaffected.

Planned unit developments, with their permitted mix of housing units, may tend to result in lower area emission of pollutants associated with space hearing. Shared walls between units result in lower heating requirements, and consequently lower emissions.

References:

--Hagevik, et al. op.cit.

--Real Estate Research Corporation. op.cit.

A.5 THE AIR POLLUTION IMPACTS OF WATER AND SEWER REGULATIONS

Septic Tanks: Malfunctioning septic tanks can produce obnoxious odors throughout a community, and are a common cause for complaints in areas where on-site disposal has been installed in inappropriate places (e.g., in unsuitable soils). Where the local water table is high, septic tank effluent may not percolate into the soil but may saturate the land or fill up ditches by the sides of roads.

Package Plants: Package plants, too, may cause odors when they are not properly operated.

Sewer Systems: Conventional sewer systems create no odors unless they clog and backup, or break. Combined sanitary/storm sewer systems (common in older cities) may create odor problems.

Indirect Land Use Effects: Since the use of septic tanks requires lower density development than is usual in sewered areas, it follows that for a given level of population, an area served by septic tanks may rely more heavily on the use of automobiles--opportunities for transit are fewer, and average automobile trip length is higher. It would appear to follow that with increased auto use would come higher emissions and lower ambient air quality, but the latter cannot be demonstrated conclusively. On the one hand, air quality may well deteriorate in a central city area surrounded by low density suburbs: the congestion of cars commuting daily to the city would be greater than if extensive transit facilities supported a large fraction of the commuting population. On the other hand, ambient air quality in suburban areas is consistently higher as density declines: the marginal increase in vehicle miles traveled per capita is more than outweighed by the marginal increase in spatial volume available to disperse pollutants.

A-P.8 THE IMPACT OF SUBDIVISION ENVIRONMENTAL REVIEWS ON GENERAL ENVIRONMENTAL QUALITY

Local environmental impact statements can contain data on the impacts of a subdivision on all environmental parameters of concern here. The statement usually is directed at what impacts the project will have on the physical conditions of the site, including amounts and varieties of vegetation, general topography, unusual geologic, scenic and historical features, trails and open space links, and indigenous wildlife. Data may be required on the location of local sensitive areas, especially wetlands, and on what measures are to be taken to protect these, what techniques will be used during construction to control erosion and sedimentation, what sewage disposal techniques will be used, what impacts on subsurface conditions are expected, and what impact the project will have on town services, including traffic flow, fire and police protection, educational facilities, etc. Information on the population characteristics of the residents of the subdivision may also be included.

If the planning board finds that the developer has not adequately considered the environmental impacts of his plan, and does not amend his project accordingly, subdivision permits may be withheld. Thus, the local EIS may be a powerful instrument for maintaining environmental quality while allowing growth to occur.

References:
--See Section VIII, Local Environmental Impact Review.

A.12 THE AIR POLLUTION AND ENERGY IMPACTS OF BUILDING CODES

Standards for design of large buildings, for Heating, Ventilating and Air Conditioning Systems (HVAC), and particularly for insulation can have a major direct impact on the heat loss from buildings, and thus on the total energy use and indirectly on the air pollution from space heating and cooling. Higher investment costs in materials for insulation are quickly repaid in savings in energy use, but the incentive for developers is to reduce investments and increase operating and maintenance costs, since they are not involved in that part of the process. Thus, there is a need for standards to aid developers in achieving society's goals. Ordinances can require certain thicknesses of insulation, and can also require that heat losses not be more than a specified amount per square foot of floor area, as part of the building codes. It is also possible to list acceptable materials and thicknesses, but performance standards are more suitable, especially since there are manuals which given the performance of available materials and which are updated more often than would be reasonable for a standard. Insulation and seals can also reduce interior air pollution concentrations far below exterior levels.

Problems

Legal: Finding a suitable level of insulation or heat loss or window-door design standard for the area.

Administrative: Including the insulation inspection in already overworked code inspectors' workloads.

Cost: Costs of inspection, explaining the standards to builders. Costs to the industry of more complex designs.

References:
--Technology and Economics. An Overview and Critical Evaluation of the Relationship between Land Use and Energy Conservation. Federal Energy Administration, March 1976.

--Abt Associates. In the Bank or up the Chimney. HUD, 1975.

A.17 THE AIR POLLUTION IMPACTS OF BURNING ORDINANCES

Burning ordinances are an established way of controlling smoke and particulate air pollution from individual burning of wastes. They also aim at odor control and reduction of forest fire hazards.

A.20 THE IMPACT OF SEDIMENTATION AND EROSION CONTROL ORDINANCES ON AIR QUALITY

In arid areas, wind erosion contributes large amounts of particulate air pollution. This reached an extreme during the dust bowl years of the 1930s, and efforts to improve agricultural practices to reduce wind erosion have been successfully conducted since then by the Soil Conservation Service. The incorporation of standards for mulching of lands during construction periods into sedimentation and erosion control ordinances is a standard practice to prevent water erosion of soils; it may also be used to prevent wind erosion where this is a major concern. Other regulatory practices would include requirements for the covering of open piles of grains and other agricultural products, industrial chemicals, and highway deicing salts; requirements of windbreaks around areas of high wind erosion potential; and other appropriate restrictions on construction.

References:

--Soil Conservation Service. Windbreaks for Conservation. U.S. Department of Agriculture, Agricultural Information Bulletin 339, Washington, D.C.

--Agricultural Research Service. Mulches for Wind and Water Erosion Control. U.S. Department of Agriculture, ARS 41-84, Washington, D.C., July 1963.

B.1 THE IMPACT OF GENERAL DISTRICT ZONING ON MOBILE SOURCE AIR POLLUTION

The use of large lot zoning or various holding zones may result in greater dispersion of development over a community. Vehicle miles travelled per housing unit thus will increase, resulting in increased emission per housing unit of air pollutants associated with automobiles--carbon monoxide, hydrocarbons, particulates (from cars with catalytic converters), and oxides of nitrogen. The dispersion of development, however will result in a dispersion and possibly increased absorption of the automotive pollutants; general community ambient air quality may be no worse, and possibly better, than if the same population is concentrated in a smaller area, assuming present transportation technology (see B.4). Since the total population of a community zoned in large-lot districts is likely to be lower than if smaller lots are permitted, the total emission density (total emissions divided by total area) in the large-lot areas will be substantially lower than in higher density areas.

Though auto emissions tend to be greater for the longer trips associated with low density areas, the relationship of emissions to trip length is complex. Cars pollute most when they are cold (after starting) and when they are driven slowly and must accelerate repeatedly, as in areas of heavy traffic. This tends to reduce the difference between emissions generated by longer trips in low density areas and shorter trips in high density areas. Both trips involve the same start-up pollution, which is a major part of the pollutant emissions of a local trip, and cars operating in congested higher density areas give off more pollutants per mile.

References:

--Real Estate Research Corporation. op.cit. (hereafter REC)

--Hagevik, et al. op.cit.

B.2 THE IMPACT OF SENSITIVE AREA ZONING ON MOBILE SOURCE AIR POLLUTION

Buffer zones are useful for the dispersion of air pollutants from roads and highways, but roads and highways are incompatible with the protection of sensitive areas. Tree ordinances are more appropriate means to establish air pollution buffering on major local roads (see B.18).

References:

--Hagevik, et al. op.cit.

--Briggs, T.; M. Overstreet; A. Kothari; & T. Devitt. Air Pollution Considerations in Residential Planning. Prepared for EPA and HUD, July 1974.

B.4 THE IMPACTS OF FLEXIBLE ZONING ON MOBILE SOURCE AIR POLLUTION

Cluster subdivisions and PUDs tend to concentrate housing units together, and siting can be done in such a way as to reduce the average auto local trip between home and frequently used local facilities, such as shopping centers. This tends to reduce the total vehicle miles traveled in such communities,* with consequent reductions in total automotive emissions. The reduction in vehicle miles traveled is probably not large, however, and when high cold-start emissions factors are considered, as well as the "hot-spot' problems of the increased local density of traffic in cluster developments or PUDs, the savings are probably negligible.

---

*It is not know how significant such reductions are. The provision of shopping opportunities in PUDs is supposed to enable residents to avoid long shopping trips, but some studies suggest that residents still prefer to shop at major regional shopping centers where prices are lower and merchandise selection wider.

The real benefit of planning for cluster developments and PUDs does not lie in present emissions reductions or ambient air quality improvements, which are probably small, but in the increased compatibility of such developments with future forms of transportation. Dispersed sprawl development is almost prohibitively expensive to serve by public transportation, but increased clustering of housing is much more compatible with dial-a-bus, conventional bus, rapid rail, commuter rail, and other forms of public transportation which are likely to become more popular in the future.

References:

--RERC. op.cit.

--Christensen, Kathleen. "Social Preferences and Urban Form." The Urban Institute, Washington, D.C., 1975.

B.7 THE IMPACTS OF STREET DESIGN ON MOBILE SOURCE AIR POLLUTION

The design of streets within subdivisions may affect localized auto-exhaust pollution levels. Cluster subdivisions offer an opportunity to shorten street lengths with a view to reducing average auto trip distances and to making housing patterns more compatible with changing transportation technology (see B.4).

References:

--Hagevik, et al. op.cit.

B.16 THE IMPACT OF TREE ORDINANCES ON MOBILE SOURCE AIR POLLUTION

Trees along the sides of major roads may serve as a buffer for some air pollutants, but their function is minimal. Some ordinances allege the air pollution benefits of tree ordinances in their statements of purposes, but insofar as they accrue to all, such benefits would require very large buffers (see D.2, WOODLANDS PROTECTION ORDINANCES). Statements of purpose alleging the oxygen generation capacity of trees as a benefit to the environment are also found, but in realistic terms, such arguments in favor of tree ordinances are unfounded.

References:

--Thurow, et al. op.cit.

--Briggs, et al. op.cit.

D.1 THE IMPACT OF GENERAL DISTRICT ZONING ON NON-POINT SOURCE WATER POLLUTION

Large-lot (or "open-space") zoning results in less sedimentation and erosion than does higher density zoning, but probably more than flexible zoning alternatives, on a unit by unit basis. Large-lot zoning with minimum lot sizes of one acre and above usually implies upper income housing only, except in rural areas. Homes are likely to be built in scattered locations across a district, according to the location of the most attractive sites. It may be difficult to regulate the erosion and sedimentation control practices of such piece-by-piece development. Where development does in fact fill in large lot zoning districts completely, one may expect that the development will have more of an impact on local stream water quality than will the same number of units in flexible zoning configurations (clusters or PUDs), since little or no area is left in its natural state, unlandscaped and undeveloped. Lawns, for instance, are less permeable than land in its natural state, and will generate more runoff and consequently more erosion and sedimentation in streams. Areas which are naturally sensitive to erosion (hillsides, stripped woodlands, etc.) are often the first sites developed, because of their aesthetic qualities, with serious adverse impacts on erosion and sedimentation problems.

Large-lot zoning is less effective than flexible zoning alternatives in reducing runoff, and maintaining groundwater recharge, holding the number of units constant. It is superior to high density zoning configurations under conventional development practices, however, since it results in fewer units built)lower overall community densities). This raises controversial legal and social issues over community population ceilings which are beyond the scope of this report.

References:

--RERC. op.cit.

--Tourbier J. Water Resources Protection Measures in Land Development. Delaware University. Prepared for Office of Water Resources Research, April 1974.

D.2 THE IMPACT OF SENSITIVE AREA ZONING ON NON-POINT SOURCE WATER POLLUTION

Wetlands Conservancy Districts:

Wetlands trap and store nutrients from upland runoff, and serve as a settling basin for silt from upland erosion. Removing wetlands by filling will thus immediately affect adjacent waters by increasing the flow of nutrient laden runoff into them. The turbidity of adjacent streams will also rise, as sediments from runoff no longer filter out by the wetland. The dense plant communities of wetlands also slow the speed of upland runoff, thus decreasing its erosion potential.

Wetlands are extremely susceptible to eutrophication from urbanization. Increased sediment loads from adjacent lands can seriously disrupt the natural ecology of wetlands, and exhaust their capabilities for acting as natural filters and sediment traps within a few years. Thus, wetlands protection should be coupled with measures to control runoff, sedimentation and erosion. (see below; see also D.21 and D.22)

Hillside or Steep Slope Development Regulation

Hillside development regulations decrease runoff and erosion by protecting the underlying geology of slopes through grading restrictions and by maintaining the vegetative cover of slopes through restrictions on clearning and stripping. With these restrictions, development of hillsides can greatly increase sediment loads in streams, and stream eutrophication can become a serious water quality problem.

Steep slope protection is especially important in coordination with wetlands conservation. Development on slopes can so increase the nutrient and sediment load reaching local wetlands that the wetlands themselves will eutrophy within a few years.

Streambank Protection

The establishment of buffer zones along streambanks protects streamwater quality through avoidance of thermal pollution and excessive sedimentation.

Thermal pollution can be a problem when the roads and other impervious surfaces associated with development increase the maximum and decrease the minimum temperatures of water runoff reaching the streams. Natural groundcovers next to streams do not react as quickly to ambient variations in temperatures, and stabilize stream temperatures throughout the year.

Buffer zones beside streams also limit sedimentation of streams, and, therefore, reduce stream eutrophication.

Woodlands Protection

Woodlands protection may greatly reduce sedimentation of streams. Forest soils are highly erodable, and destruction of trees or the forest floor covering can greatly increase sedimentation from woodland areas.

References:
--Thurow, *et al*. *op.cit.*

D.5 THE IMPACT OF WATER AND SEWER REGULATIONS ON NON-POINT SOURCE WATER POLLUTION

Septic Tanks can be a serious source of water pollution in streams: clogged seepage fields or malfunctioning or improperly installed systems are at fault. Septic tank failures do not commonly occur on such a scale as to constitute chronic non-point source water pollution, except where the land is entirely unsuitable for their use in the first place: unincorporated areas not subject to sanitation codes have sometimes been developed with septic tanks even though water tables are too high or soils insufficiently permeable to allow them to function properly. For the most part, however, septic tank failures are less of a threat to areawide water pollution than they are to public health locally.

Package Plants do not contribute to area source pollution.

Sewers do not contribute to area source pollution unless major breaks occur. The use of combined sewers, with their automatic overflow mechanisms, might be considered an exception.

References:
--See Section IV, On-Site Wastewater Management

D.6 THE IMPACT OF SUBDIVISION STORMWATER REQUIREMENTS ON WATER QUALITY

Though rainwater itself is clean, stormwater picks up debris, litter, chemicals and soil sediments before it enters a stormsewer system. Conventional stormsewer systems have a negative impact on water quality in receiving streams. The most common problem is combined sewer overflows in older systems, with consequent bypassing of raw effluent into receiving streams and possible backup of raw sanitary sewage onto the streets of communities. This problem occurs when storms of greater than design frequency occur or in overloaded sections of the city collection system.

A less obvious problem occurs with both combined sewers and separated systems and is due to chronic underflow rather than occasional overflow. Since stormsewers are built to handle large storms, they are comparatively oversized for small ones. Runoff from average storms travels slowly through the pipes, and much, if not most, of its pollution load may settle out and remain within the pipes. The runoff from a large storm will scour out the sediment left from many smaller storms, and discharge it into streams along with its own pollution load, resulting in occasional massive pollutant dosages to streams from stormsewer discharge points.

Conventional stormsewer requirements reduce non-point source pollution of local streams, but do so at the expense of point source pollution downstream.

References:

--Process Research, Inc. Dorchester Bay Study. Prepared for the Metropolitan District Commission, Boston, Massachusetts, 1972.

--U.S. Environmental Protection Agency. Water Quality Management Planning for Urban Runoff. Washington, D.C., December 1974.

D.18 THE IMPACT OF PARKING ORDINANCES ON NON-POINT SOURCE WATER POLLUTION

Parking ordinances permit more efficient street cleaning and consequently are a valuable tool for reducing water pollution from urban runoff.

Reference:
--See Section II, Transportation and Parking Management.

D.20 THE IMPACT OF SEDIMENTATION/EROSION CONTROL ORDINANCES ON NON-POINT SOURCE WATER POLLUTION

A major object of sedimentation and erosion control ordinances is to protect surface water quality, especially in streams. As higher quantities of sediment are carried in streams, the sediment's organic content will deplete stream oxygen, resulting in depletion of fish population and proliferation of algae.

The increased turbidity of the water will also cut off light to the deeper waters, killing off many species of plants and fish. The biological depletion of a sediment choked stream will seriously alter the ecology of the waterway. High temporary sediment loads, such as those associated with single large construction projects, may be just as damaging to stream ecology as chonic lower levels, and possibly more so.

Massive doses of sediment may wipe out major sectors of biological communities, which may then require years to recover. Thus, sedimentation and erosion control measures are valuable to water quality even if they affect a small number of projects.

Reference:
--See Section V, Stormwater Management.

D.21 THE IMPACT OF RUNOFF CONTROL ORDINANCES ON NON-POINT SOURCE WATER POLLUTION

Urban runoff pollutes streams both because of the substances it carries and because of its temperature.

Many pollutants are carried into stormwater, such as street litter, soil, fertilizers, pesticides, and other toxic substances (especially from local industrial operations). These may represent BOD (biological oxygen demand) loadings higher than those of raw sewage.

Thermal pollution of streams can also be a major problem. Because impervious surfaces such as paving and roof tops gain and lose heat quickly, their maximum and minimum temperatures are greater than those of the vegetated ground surface that they replace. Sheet runoff from these surfaces may, therefore, alter the annual temperature extremes of streams, with major impacts on biological communities. Thermal pollution may also be caused indirectly by widening of the stream channel due to increased peak flows: as banks are eroded and undermined, trees which shade the stream are removed, causing stream temperatures to rise.

Reference:
--See Section V, Stormwater Management.

E.3 THE IMPACT OF PERFORMANCE ZONES ON POINT SOURCE WATER POLLUTION

Effluent Allotment Ordinance: Effluent allotment ordinances may place discharge quality and quantity standards on package plants* which are more stringent than the standards imposed by federal regulations. This will yield higher water quality in the controlled streams. The ordinances may also prohibit any discharge at all to certain streams deemed by the community to be too fragile to assimilate any effluent. (See G.3)

References:
--See Section IV, On Site Wastewater Disposal.

E.5 THE IMPACT OF WATER AND SEWER REGULATIONS ON POINT SOURCE POLLUTION OF STREAMS

Septic Tanks do not have a point source impact on streams.

Package Plants may contribute substantial pollution from their outfalls (some package plants are designed for use with seepage fields, however). Although most such plants are designed to operate at so-called secondary treatment levels (the same standard as applies to most municipal facilities built today) they seldom approach their design standards in actual field operations, and may actually be performing negligible treatment, in some cases. For this reason, they are often prohibited by local ordinances, or allowed as only interim measures prior to the availability of a conventional municipal sewerage system.

Sewers (and their associated treatment plants) may also have a substantial negative effect on streams below their discharge point. Conventional plants often operate well below their design efficiency (usually expected to achieve ninety percent removal of biological oxygen demand). Even when operating to standard, a conventional plant will degrade a stream to some extent unless it is already so polluted that the stream water is lower quality than the plant effluent. In addition, the present trend toward regionalization of sewage treatment is resulting in major single point plant discharges replacing a multitude of smaller ones. What the impact of such large discharges is on stream water quality and ecology is not known.

Reference:
--See Section IV, On-Site Wastewater Disposal.

E.6 THE IMPACT OF STORMWATER MANAGEMENT REQUIREMENTS ON POINT SOURCE WATER POLLUTION

Conventional Stormsewers: Managing stormwater entirely through conventional stormsewers tends to reduce groundwater recharge, since it removes substantial amounts of rainfall from the site which under natural conditions would infiltrate the ground.

Reference:
--See Section V, Stormwater Management.

F.1 THE IMPACT OF GENERAL DISTRICT ZONING ON GROUNDWATER QUALITY

Large-lot zoning enables communities with adequate soil percolation to permit the use of septic tanks for new development, since sufficient land is available to each unit to dispose of wastes through drainage fields. This can help maintain groundwater recharge and will not diminish groundwater quality if the systems are properly designed and maintained. The soil acts as a highly efficient filter and absorbs virtually all wastes. The use of septic tanks enables communities to limit their sewerage systems to those areas which cannot dispose of waste on-site, and if the large-lot zones comprise a sufficiently large sector of the community, this will substantially reduce point source discharges of streams, with beneficial effects on stream water quality.

Reference:
--Galamar Builders Corp. v. Tuttle, 29 N.Y. 2d 221, 325 N.Y. 2nd 933 (1971).

F.5 THE IMPACT OF WATER AND SEWER REGULATIONS ON GROUNDWATER QUALITY

Septic Tanks may have a degrading effect on local groundwater if the bottom of the seepage field (below the surface) is too close to the water table: in that case, bacteria, viruses, chemicals, and nutrients, can contaminate the groundwater. The definition of "too close" depends on the permeability of local soils and their filtering capacity, but is interpreted differently in different states. On the eastern seaboard, septic tanks may be used if the water table is about five feet below the lowest depth of the tile field--in the west, some states specify fifty foot separations.

Seepage fields may become less efficient with age, and may become too clogged to use. For this reason, they are often viewed as an interim waste management technique in suburban areas, where lot sizes are too small to permit construction of a replacement seepage field. In rural areas where lots tend to be large, seepage fields may be replaced and septic tank systems may be an efficient and environmentally sound method of sanitary waste disposal over the long term.

Package Plants which use seepage fields present the same danger to groundwater supplies as do conventional septic tanks.

Sewer Systems and Municipal Treatment: Conventional sewer systems do not contaminate groundwater except under unusual situations of old systems in areas of high groundwater.

References:

--Patterson, J.W., et al. Septic Tanks and the Environment. Illinois Institute of Technology, June 1971. NTIS: PB-204-519.

--See also, Section IV. On-Site Wastewater Disposal.

F.6 THE IMPACT OF SUBDIVISION STORMWATER MANAGEMENT ON GROUNDWATER QUALITY

Groundwater quality is generally not affected by stormwater management pograms, except where infiltration of pollutants associated with urban surfaces occurs in areas where outcroppings of groundwater are near the surface.

Reference:

--See Section V, Stormwater Management.

G.2 THE IMPACT OF SENSITIVE AREA ZONING ON FLOODING

Wetlands Conservancy Districts: Wetlands offer important flood protection to communities. They are able to stabilize water levels by holding excess water in peaty soils, and by retarding the speed of flood flows. The exact ability of wetlands to hold or retard flood waters varies according to the wetland ecology and the local climate.

Hillside or Steep Slope Development Regulations: The development of hillsides can influence local flooding problems since it can greatly increase the volume of runoff from the slope, and reduce the lag time between rainfall and flood peak. Regulations which maintain vegetative cover restrict both runoff volume and runoff speed.

Streambank Protection: The creation of buffer zones adjoining streambanks acts in two ways to lower flood hazards. First, by reducing development on the immediate floodplain of the stream, these zones reduce the amount of property damage a flood can do. Second, by reducing the velocity of runoff to the streams, the buffers protect the natural configuration of the stream channel. In some cases, changes in the stream's configuration can increase the peak flow of the stream during floods, increasing the possibility of property damage.

Reference:
--Thurow, et al. op.cit.

G.3 THE IMPACT OF PERFORMANCE ZONING ON FLOODING

Effluent Allotment Ordinances: Effluent allotment ordinances may regulate the volume of discharge into the receiving stream of a package plant, defined as a fraction of the total stream flow at any time. Some streams, because of their low and/or variable flow volumes over a year, may be protected from receiving any effluent at all. These ordinances have only a marginal effect on community flooding per se, but they do tend to maintain small streams within their natural chennels.

Reference:
--See Section IV, On Site Wastewater Disposal.

G.6 THE IMPACT OF SUBDIVISION REGULATIONS ON FLOODING

Conventional Stormsewer: Stormsewer systems prevent local flooding within subdivisions, unless the design storm frequency is exceeded--thus, the tendency is to require capacity to handle larger storms, with possible negative secondary results in terms of reduced reliance on on-site disposal of stormwater, and underemphasis of runoff reduction and other non-structural methods of flood control.

Flooding problems downstream of a subdivision may be compounded by conventional stormsewering, since flood peaks are accelerated by the efficient removal of stormwater from large urban areas.

Reference:
--See Section V, Stormwater Management.

G.12 THE IMPACT OF BUILDING CODES ON FLOODING

Building codes may involve the use of innovative roof designs and guttering to hold stormwater on buildings for a prolonged period, retarding the development of flood peaks and reducing their intensity.

Reference:
--Tourbier. op.cit.

G.14 THE IMPACT OF FLOOD CONTROL ORDINANCES ON FLOODING

Runoff Control: (See G.21)

Floodplain Management: Floodplain management controls permissable land uses in the floodplain, seeking to minimize potential property damage. By reducing the level of development allowed, not only does floodplain management reduce the total value of property vulnerable to floods, it reduces the total amount of impervious surface in the floodplain. This, in turn, tends to reduce the maximum flood stage, since it retards flood peaking and allows greater absorption of water into the ground.

By restricting permissible land uses to non-structural and temporary commercial uses, floodplain management preserves open space, wildlife habitat, and recreational opportunities. (See K.2 and G.21)

Legal Issues

The passage of the National Flood Insurance Act has given strength to controls on new development in the floodplain. The most difficult problem to address is that of non-conforming uses. Temporary structures, such as billboards, can be removed after they are amortized, but even then courts tend to examine the peculiar facts of each case in making their judgements.* Furthermore, temporary structures are much less of a problem then permanent ones. Basic policy on floodplain management under the HUD Act is to simply require insurance of non-conforming uses, and to place at least the following additional requirements on them:

- The use cannot be expanded in such a way as to increase its non-conformity.
- Structural alterations should not exceed a stated percent of the value of the use.
- If use is discontinued for a certain period, future use shall be in conformance with the ordinance.
- If more than fifty percent of the structure is destroyed by flood, it shall be removed or reconstructed in conformance to the ordinance.

---

*Minnesota's statute requiring amortization of billboards over a four year period was challenged in Khicker v. State of Minnesota, 197 N.W. 2d 434 (1972). The plaintiff won the right to a full hearing on the facts, despite the clear requirement for billboard removal after amortization.

Administrative Issues

The mapping of 100-year flood contours may be a major problem. Technical assistance is available through the Soil Conservation Service, the Army Corps of Engineers, and the U.S. Geological Survey. The extent of alluvial deposits can be used as an approximation of the plain. Maps indicating peak flows may be useful but are likely to exceed the 100-year flood; existing flood plain maps are often seriously defective for site planning purposes.

The Federal Insurance Administration is proposing to distinguish "floodmaps" and "flood-fringe" areas within the 100-year floodplain. Once federally supported studies are issued to communities with this information, a local mapping of this distinction would have to amend the simpler 100-year floodplain definition recommended above. In addition, the permit procedure for allowing compatible uses would be amended to broaden possible uses in the flood fringe, where velocity of the flood water is slow, provided proper protection is provided.*

References:

--Debo, N. Survey and Analysis of Urban Drainage Ordinances and Recommended Model Ordinance. Prepared for the Office of Water Research and Technology, February 1975. NTIS: PB-240-817.

--Iowa Water Resources Research Institute. Flood Plain Management and Implementation Strategies FPM Programs. Iowa State University, December 1974.

--Tourbier and Westmacott. Water Resources Protection Measures in Land Development. Prepared for the Office of Water Research and Technology, April 1974.

--Robinson, M. Flood Control in Community Planning. Prepared for the Office of Water Research and Technology, June 1972.

--See also, Section V, Stormwater Management, and Section VIII, Subdivision Ordinances for Local Environmental Review.

---

*This protection might include permanent landfills, elevation of structures, and structural floodproofing such as watertight construction, reinforcement, added mass to resist flotation, mechanical pumping, and sanitary and stormsewer protection valves.

G.16 THE IMPACT OF TREE ORDINANCES ON FLOOD CONTROL

Insofar as they tend to retard runoff, trees protected by these ordinances may have a limited positive impact on flood control, but it is certainly a marginal one.

Reference:
--Thurow, et al. op.cit.

G.20 THE IMPACT OF EROSION AND SEDIMENTATION CONTROLS ON FLOODING

As sediment levels rise in streams, some begin to settle out: heavier particles (such as gravels and sands) are deposited first, and fines (clays, silts, fine sand) later. This raises the bottom of the stream, and increased flood levels. In some cases, such alterations of the stream bed may cause changes in the stream channel itself, in the source of which additional erosion and sedimentation will occur from streambanks.

Reference:
--Thurow, et al. op.cit.

G.21 THE IMPACT OF RUNOFF CONTROL ORDINANCES ON FLOODING

Runoff from developed areas is greatly in excess of that for natural areas. A study in Nassau County, New York, showed that the mean annual flood may be from 1.1 to 4.6 times greater under conditions of urbanization under different intensities.

Rainwater falling on the ground is redistributed in four ways. Part of it infiltrates the ground and recharges deep groundwater formations. Another faction achieves only shallow infiltration and travels slowly across the land, eventually seeping into streams, lakes, or the ocean. A substantial amount (usually 30-40%) evaporates directly into the atmosphere again. The remainder travels across the surface rapidly in the form of runoff.

Development lowers the average permeability of the land surface, altering the original balance between evapotranspiration, shallow infiltration, deep infiltration, and runoff. The following table presents the basic distribution changes found by one study.*

Thus, the impact on stream water flow is severe: not only is a substantially increased percentage of total rainfall being discharged to streams directly, but the rate of discharge also rises. Under most natural conditions, rainfall is absorbed into the soil until saturation; impervious surfaces shed their runoff immediately, increasing flow peaks. Minimum stream water flow may also be altered by increased runoff; because development reduces shallow and deep infiltration, recharge of streams from groundwater is reduced during dry season, for many streams draw major portions of their flow in this way.

---

*Tourbier, op.cit.

Impervious Surfaces	Evapo-transpiration	Shallow Infiltration	Deep Infiltration	Runoff
0% (natural condition)	40%	25%	25%	10%
10-20%	38%	21%	21%	20%
35-50%	35%	20%	15%	30%
75-100%	30%	10%	5%	55%

Reference:
--Thurow, et al. op.cit.

H.2 THE IMPACT OF SENSITIVE AREA ZONING ON WATER SUPPLY

The fundamental impact of sensitive area protection on water supply will be on groundwater recharge. Groundwater recharge protection ordinances have this object as their prime concern, of course, but the other sensitive area protection zones also tend to expedite groundwater recharge.

Wetlands Conservancy Districts: There are several different kinds of wetlands. Some are perched above a water table on a layer of impervious clay--protection of the zone, therefore, does not aid groundwater recharge. Others constitute groundwater discharge zones, where the water table outcrops at the surface and does not receive a net inflow; these are generally restricted to the arid western regions of the country, they do not fulfill a groundwater recharge function. Where part of a wetland extends below the water table, a significant groundwater recharge area may form; it is able to recharge the groundwater. If the water table of such a wetland declines during part of the year--for instance, if the wetland is a sedge meadow or shallow marsh (a "temporary wetland")--then its groundwater recharge function may be particularly important. The vegetation of such wetlands is able to hold a great deal of moisture from a rainfall, which it gradually returns to the water table. These areas can be drained and filled relatively cheaply to obtain buildable homesites, and so are usually the first lost to development.

Hillside Development Regulations: While hillsides are not prime groundwater recharge areas--and the intent of regulation is mainly to control drainage and erosion--they nevertheless can have an adverse effect on groundwater recharge if not protected. Development significantly increases runoff of water which would otherwise be held in the soil and run slowly downhill at a short distance beneath the surface. The lag time increases the time available for areas at the foot of the slope to return water gradually to the water table. Thus, where runoff is accelerated off of slopes, recharge areas at the base of slopes may quickly become saturated and shed surplus water into streams.

Woodlands Protection Ordinances: Woodlands generally have a porous soil which is good at holding water. The forest canopy and low shrubs of a forest break the form of rainfall, decreasing its erosive power and allowing more of it to be absorbed into the soil. However, a great deal of the water held in forest soil is transpired by trees and evaporated again into the air, causing forests to be areas of comparatively low groundwater recharge. If clearcut, groundwater recharge of the woodland area can be increased by more than twenty percent, although irresponsible clear cutting can result in substantial net damage to water resources through the erosion of soils and severe sedimentation of streams.

Groundwater Recharge Area Protection: As is clear from the discussion above, groundwater recharge may be a partial purpose of protection of a variety of environmentally sensitive zones. Where recharge is a particular problem in terms of community water supplies, groundwater recharge areas may be designated as an overlay zone on developed areas to dictate recharge performance standards on a lot-by-lot basis. These controls generally place an upper limit on the amount of impervious surface allowed on a given site, and may require retention and disposal of stormwater on site, though the soil. Stricter limits limiting or excluding development altogether may be imposed if the groundwater would also be sensitive to pollution (such as in areas with particularly high water tables). Such a protection measure virtually becomes wetlands protection with a single purpose--to protect groundwater quantity and quality.*

Reference:
--Thurow, et al. op.cit.

H.5 THE IMPACT OF WATER AND SEWER REGULATIONS ON WATER SUPPLY

Septic Tank systems often are an environmentally sound way to recharge groundwater supplies. There has been considerable recent interest in the use of the land itself as a filter to achieve high degrees of wastewater treatment at low cost. In a properly managed system, the earth can extract virtually all the impurities of wastewater, including toxic metals and viruses, allowing purified water to return to aquifers. The same principle is used by a septic tank. If property maintained, septic tanks are one of the best methods of recycling water supplies.

---

*Such a case is found in Florida, where the Volusia County Water Recharge Ordinance states its purpose as "to protect the water resources of Volusia County, (and to) prevent the development or use of the land in the Potential Recharge Area in a manner tending to adversely affect the quality of water."

Package Plants using seepage fields may also be comparatively beneficial to groundwater maintenance if they are properly operated.

Sewers remove all effluent off-site. Water extracted from local wells is, therefore, not returned to the ground, but is discharged into streams. In some areas, this has had serious consequences in terms of groundwater depletion.*

H.10 THE IMPACT OF LANDBANKING ON WATER SUPPLY

Landbanking, in practice if not in name, has historically been used by public and private water companies to protect watershed lands from development. Watersheds have not received much attention lately as environmentally sensitive zones, since those areas of the United States that consider them so have long since purchased them. Watershed protection has traditionally been an issue in the Northeastern states, where public water supplies were first established. These and a few other states,** with clean and abundant surface supplies available within an acceptable distance of major cities, have opted for watershed protection as their major mode of water quality safeguard--other states, with lower quality water, have from the start relied on filtration and disinfection techniques to achieve high-quality water.

To an extent, the use of landbanking to protect watersheds used for drinking water production is a moot issue--very few states now have the option to increase the watershed lands held out of development, since land prices are rising prohibitively and the option has usually already been preempted by developers. There is also debate over the necessity of protection--it is argued that treatment capabilities exist to process the lowest grades of raw water into safe drinking water. Since the passage of the Safe Drinking Water Act, this point is reopened for debate. While it is true that treatment is readily available to protect against bacterial and viral contamination--the only form of pathogenic contamination for which there are generally acceptable standards--new contaminants are entering water supplies for which standards have not yet been formulated. These are the products of industrial society--the pesticides, industrial effluents, domestic and toxic wastes which were unknown when public water supplies were first set up.

Public watersheds, then, should remain protected from urban development wherever possible, at least until treatment standards applicable to such substances as chlorinated hydrocarbons and heavy metals have been formulated, and processing machinery is available. Watersheds are compatible with some valuable land uses such as recreation, conservation, and open space protection, and as such may possibly be zoned as sensitive lands. Until scientific and legal grounds for this protection are widely recognized, however, communities wishing to preserve the option for watershed protection may be obliged in the interim to acquire the land outright.

---

*The City of Venice, Italy, is one of the most dramatic examples of the penalties paid for groundwater depletion: hundreds of private wells have been withdrawing excessive amounts of fresh water from beneath the city for hundreds of years, causing the city literally to sink into the ocean. Recent provision of remote fresh water supplies has stopped this process, and the city is rising again.

**Washington State is the primary example, as well as others in the Pacific Northwest.

Reference:

--Urban Systems Research & Engineering, Inc. Recreation on Water Supply Reservoirs. Prepared for the Council on Environmental Quality, Washington, D.C., 1975.

H.16 THE IMPACT OF RUNOFF CONTROL ORDINANCES ON WATER SUPPLY

Trees do improve soil permeability, and, therefore, improve groundwater recharge locally. Their benefits would be related both to the location of groundwater recharge areas and to the number of trees protected. The groundwater recharge benefits of tree protection are seldom, if ever, alleged in tree ordinances.

References:

--Roy F. Weston, Inc. A Manual on Storm Water Management for Evaluating and Mitigating the Effects of Land Use Changes on Runoff. The Maryland National Capital Park and Planning Commission, (undated).

--Coughlin, R., & T. Hammer. Stream Quality Preservation through Planned Urban Development. Environmental Protection Agency, Office of Research and Monitoring, Washington, D.C., May 1973. EPA-R5-73-019.

H.20 THE IMPACT OF SEDIMENTATION AND EROSION CONTROL ORDINANCES ON WATER SUPPLY

The sedimentation in local streams of fine silts and clays may clog their connections with major groundwater formations, depleting community water resources. Correction of sedimentation problems can lead to a re-establishment of these corrections, to the benefit of groundwater recharge.

References:

--Thurow, et al. op.cit.

H.21 WATER QUANTITY: SUPPLY/REGULATIONS/ORDINANCES: RUNOFF CONTROL ORDINANCES

Runoff control ordinances can have a positive effect on water supply sources because they tend to maintain groundwater recharge. Measures which enhance infiltration of rainwater into the earth not only maintain subsurface water sources, but also tend to maintain minimum flows in streams to a higher level than might otherwise be the case in developed areas.

I.4 THE IMPACT OF WATER AND SEWER REGULATIONS ON SOLID WASTE

Conventional municipal treatment requires disposal of large amounts of sludge produced by the treatment process. This solid waste may either be buried or incinerated, but both processes create secondary environmental problems.

Septic tanks and package plants also create solid wastes which must be disposed of though it is generally felt that with them the problem is less severe.

Reference:
--See Section IV, On-Site Wastewater Disposal, and
Section VII, Soild Waste Control.

I.10 THE IMPACT OF LAND BANKING ON SOLID WASTE

The disposal of solid waste is and will continue to be primarily by landfill. However, particularly in urban areas, acquisition of land suitable for disposal sites is difficult. Citizens are understandably distressed by the prospect of a "dump" near their homes; wetlands and other areas with poor soils or high water tables are unsuitable because of environmental damage to the ground and surface waters from leachate and runoff. Incinerators and similar methods which reduce the amounts of fill are expensive and environmentally damaging in their own ways. The problem of solid waste disposal has been rated as the most important issue facing cities by the National League of Cities. Untried and expensive resource recovery technology is supported because it meets with public acceptance, while environmentally safe landfills can be designed at significantly lower costs and impacts. Methods are needed of choosing and acquiring sites for landfills in urban and suburban areas.

Prime land is necessary, so the cost will be high. The main costs, though, are in the negotiation process necessary to get and use the site, and in the design of a fill which will meet standards.

Legal Issues

None, except the cost of the likely court battle, and issues of whether fills can be put in land zoned (usually) as residential. A change in zoning to allow sanitary landfills in residential areas might be reasonable as an aid in finding sites. However, traffic and other impacts make it really unsuitable for residential areas.

Administrative Issues

The siting problem is a key issue in solid waste management, and there is no easy solution to it. Public hearings are required, major battles will occur, and if the site choice is ever moved,the whole process starts over again. Regionalization as a solution has not worked in practice, because of the political issues involved in receiving another community's garbage. Eminent domain powers can be used, but these only lead to sites where land is cheap and the population is disadvantaged--and even there, difficulties occur. Aids to siting might include zoning residential areas fr landfills; requiring land dedication in developments so that dedicated lands can be combined in suitable landfill, and growth management controls where the site of the landfill is chosen ahead of the development around it.

Local environmental impact statements and other such requirements delay siting, leading to a major environmental harm since the siting process traditionally starts only after the situation is desparate.

References:

--National League of Cities. Cities and the Nation's Disposal Crisis. Reprinted from Nation's Cities, 1973.

--National Association of Counties Research Foundation. Guidelines for Local Governments on Solid Waste Management. Public Health Service Publication No. 2084, 1971.

--Colonna, R., & C. McLaren. Decision-Makers Guide in Solid Waste Management. Environmental Protection Agency, 1974 (Report SW-500).

--Vincent, B. "The Opportunity and Impact of Land Use Programs for Solid Waste Management," EPA-OSWMP Issue Paper, November 1974.

--Hudson, J.; F. Gross; D.G. Wilson; & D.H. Marks. Evaluation of Policy-Related Research in the Field of Municipal Solid Waste Management. Report R7456, Department of Civil Engineering, Massachusetts Institute of Technology, 1974.

--Gross, F. Issues in the Regionalization of Solid Waste Management Planning. Civil Engineering Thesis, Massachusetts Institute of Technology, 1975.

--See also Section VII, Solid Waste Control..

I.11 THE IMPACT OF CONSTRUCTION CODES ON SOLID WASTE

Building demolition generates large amounts of fairly inert fill. The construction code should contain provisions for removal and, if possible, recycling of these materials. Special care should be taken of toxic materials, such as asbestos insulation.

Reference:
--Hudson, et al. op.cit.

--See also Section VII, Solid Waste Control.

I.12 THE IMPACT OF BUILDING CODES ON SOLID WASTE

Storage should be provided in a sanitary manner; this can be covered in sanitation ordinances or in building codes. Design of buildings for easier recycling when demolished is possible, but minor.

References:
--Hudson, et al. op.cit.

--See also Section VII, Solid Waste Control.

J.15 THE IMPACT OF SANITATION ORDINANCES ON NOISE

Noise from collection operations can be a problem and collections should be scheduled for daytime hours unless traffic conditions make it impossible. The use of disposal containers and plastic cans should be encouraged. (see 15)

Reference:
--See Section VI, Noise Control Ordinances, and Section VII, Solid Waste Control.

J.16 THE IMPACT OF TREE ORDINANCES ON NOISE

Noise control is also alleged as a benefit of tree ordinances, with more justification than air pollution control. Generally, it is felt that trees form a noise barrier between traffic and other land uses, making them particularly valuable in residential neighborhoods. The noise attenuation capability of trees is related to the species in question, the density of planting, and the season. It may also be inferred that most trees will be more effective blocking the noise reaching second stories of houses since little of their foliage is near the ground.*

References:
--Thurow, et al. op.cit.

---

*Clearly, deciduous trees lose much of their noise control effectiveness when they have lost their leaves, making them definitely a questionable element in any comprehensive community noise control program.

--Urban Systems Research & Engineering, Inc. The Audible Landscape. Prepared for the Federal Highway Administration, Department of Transportation, Washington, D.C. 1972.

J.19 NOISE REGULATIONS/ORDINANCES: NOISE CONTROL ORDINANCES

Standards can be set on vehicles and equipment sold in communities or used for government work. Building design requirements can reduce sound propagation from outside, or from other rooms inside. Subdivision layouts can be required to provide barriers or bersm, or simple open space to attentuate sound from sources such as highways. Noise ordinances related to fixed sources can be either technical, involving measurement of sound levels, or judgemental. The technical ones are more accurate and less discretionary, but require equipment and trained personnel, who may not be available when needed. The judgemental ones are open to charges of capriciousness. Zoning controls may be used to keep noisy and quiet uses separate, or to require certain levels of performance at the property line, which can be enforced by the community.

Reference:

--See Section VI, Noise Control Ordinances.

K.5 THE IMPACT OF WATER AND SEWER REGULATIONS ON TOXIC SUBSTANCES

Sewage effluents from residential areas contain comparatively few toxic subtances. Where seepage fields are used, there is little danger that toxic wastes can be a hazard to human health. However, introduction of some chemical solvents or other chemicals into septic tanks can disrupt or destroy the bacteriological processes which break down sewage and cause septic tank malfunction. Similarly, with package plants, toxic effluents from one household can damage the plant process and disrupt the system's entire operation--one reason such plants are held in disfavor.

K.12 THE IMPACT OF BUILDING CODES ON TOXIC SUBSTANCES

The use of toxic materials should be prohibited in building design. Classic examples are lead paints in interiors, lead pipes in water supply systems, and furiable asbestos insulation. It may also be desirable to prohibit the use of certain pesticides or other substances in buildings, either under the building codes or the health codes.

K.12 THE IMPACT OF BUILDING CODES ON TOXIC SUBSTANCES

The use of toxic materials should be prohibited in building design. Classic examples are lead paints in interiors and lead pipes in water supply systems. It may also be desirable to prohibit the use of certain pesticides or other substances in buildings, either under the building codes or the health codes.

K.14 THE IMPACT OF FLOOD CONTROL ORDINANCES ON TOXIC SUBSTANCES

Floodplain Management. Floodplain management should restrict the storage and use in the floodplain of materials which are buoyant, explosive, soluable, expansive, flammable, or toxic to humans, animals, or plants. This is done for obvious reasons of safety and health. Other material may be stored if it is not subject to major damage by floods and owners file written statements assuming any and all damage in the event of flooding. In addition, public utilities such as sewers, electrical lines, and gas lines should be located, designed, and constructed in such a way as to minimize the possibility that they would become a threat to public safety or health if subjected to flooding.

Reference:

--Debo, T.N. Survey and Analysis of Urban Drainage Ordinances and a Recommended Model Ordinance. Office of Water Research and Technology, Georgia Institute of Technology, February 1975. NTIS: PB-240-817.

K.15 THE IMPACT OF SANITATION ORDINANCES ON TOXIC SUBSTANCES

The sanitation ordinance should provide for the separation and disposal of toxic substances such as chemical wastes at a state approved disposal site.

Reference:

--See Section VII, Solid Waste Control.

L.1 THE IMPACT OF GENERAL DISTRICT ZONING ON TRANSPORTATION ENERGY USE

Large-lot zoning, although it results in little significant reduction in auto emissions by housing unit (see B.1), does result in an increase in energy demand associated with automobile travel. Vehicle miles travelled are definitely greater if development is spread out than if it is compact--not only is each trip longer, but virtually all trips are, by necessity, auto trips. If large-lot zoning has the effect of lowering the community population ceiling, it may also happen that potential residents who cannot find housing in the community will be forced to travel farther to a more distant town, increasing the total automobile energy requirement for a given number of people.

Over the long term, large-lot zoning has the further defect of making it less economical to switch to more energy efficient local transportation modes, such as "dial-a-bus" or other public modes--housing units are so far apart that the personal automobile becomes the only logical service vehicle. Although automobiles in general are being made more fuel efficient, the largest potential transportation energy savings appear to be in a shift away from the automobile to a more energy efficient mode. (see also M.4).

Reference:
--RERC. op.cit.

L.4 THE IMPACT OF FLEXIBLE ZONING ALTERNATIVES ON ENERGY USE

Although the air quality improvements associated with cluster subdivisions and PUDs are probably not significant in most instances (see A.4), the energy saving associated with reduced automobile use can be important. Distances travelled between housing and work and shopping detinations are usually shorter with flexible zoning options, since housing can be located on shorter streets, and in the case of PUDs, support facilities can be mixed with residential land uses, enabling residents to do at least part of their shopping by foot.

As mentioned in A.1, local shopping in PUDs may turn out, in fact, to be supplementary rather than a substitute--people still seem to prefer larger shopping centers to small local shops for reasons of convenience (one-stop shopping), price, and merchandise variety. However, the flexible zoning options are almost always more compatible with the shortened route requirements of public transportation options such as "dial-a-bus," currently under consideration for use in suburban areas. In the long run, replacement of a significant portion of auto trips by these energy efficient options will result in major energy savings, especially in such repeated trip types as the daily journey to work. While in the short term, flexible zoning patterns may result in only minor transportation energy savings, the long term savings are likely to be very important.

While few cluster developments or PUDs put much emphasis on alternative non-automotive transportation, it is clear that part of the common space which occurs within a site could be used for bicycle paths, or as routes for small electric or muscle-powered cars. In Reston, Virginia, perhaps the largest single PUD in this country, pedestrian paths are routed throughout the community so that children can walk to schools and play areas without having to cross or go near conventional streets.

References:
--RERC. *op.cit.*

--Christensen. *op.cit.*

M.4 THE IMPACT OF FLEXIBLE ZONING ALTERNATIVES ON THE ENERGY USE OF BUILDINGS

Cluster subdivisions are usually composed of conventional single-family units, although in principle they could be adapted to any housing format. This menas that they cannot take advantage of the space-heating efficiencies of multiple dwellings, although a very small energy saving may accrue when clusters are situated in windy areas, such as on an open plain--there, the reduction in wind velocity caused by the housing cluster with its surrounding streets may be important enough to cut wind infiltration and conduction heat loss.*

PUDs, on the other hand, with their freedom to mix land uses, are commonly built to contain at least some, if not all, multi-family housing. Here, space-heating energy savings can be substantial. One study indicates that townhouse-type residents consume about eighty percent of the gas and electricity that conventional single family units do, that walk-up apartments require only sixty-two percent, and high-rise apartments (six stories) only fifty percent.**

Reference:
--RERC. *op.cit.*

---

*The Soil Conservation Service estimates that wind breaks of specially planted trees can, in some locations, reduce home fuel needs fifteen percent. Although clustering of housing is not as efficient a way to create a windbreak, together with appropriate landscaping it may offer some energy savings in windy areas. Reference: Department of Agriculture, Soil Conservation Service, Agricultural Information Bulletin 339, Washington, D.C., 1969.

**The figures are for operation and maintenance expenditures only--i.e., average fuel costs over a year for the two energy sources mentioned. This study did not take climatic effects into account, and represents only a theoretical national average. Obviously, where no space heating is required, no heating costs will be incurred--in that case, it is appropriate to consider air conditioning costs, if these are incurred. The figures quoted do, however, give an indication of the relative energy efficiencies of new units constructed under standard building technology. Reference: RERC, *op.cit*.

M.13 THE IMPACT OF HEALTH CODES ON ENERGY USE

Health codes provide standards for capacity of heating systems by giving the ambient temperatures which must be met for outside temperatures. Lower standards, if reasonable by other considerations, would reduce energy use for space heating and also reduce air pollution from space heating.

Comments

A minor possibility. Not much is written on this subject and it is probably more trouble to change than it is worth in most communities. Reductions in interior temperatures are a good idea, but there is no easy way to legislate them. Voluntary efforts must be relied upon.

N.11 THE IMPACT OF CONSTRUCTION CODES ON SOIL LOSS

A large portion of the soil loss from urban areas is a result of construction and the clearing of land it requires. Codes which regulate construction can be used to remedy this, as can specialized sedimentation and erosion control ordinances.

Reference:
--See Section V, Stormwater Management.

N.20 THE IMPACT OF SEDIMENTATION AND EROSION CONTROL ON SOIL LOSS

The loss of soils by erosion is a major concern: must of the impetus behind sedimentation and erosion control reforms has come from soil conservation districts throughout the United States. Where fertile topsoil is lost through erosion and must be replaced for landscape purposes, this represents an unnecessary environmental cost as well as an economic one.

In rapidly developing areas, erosion loss per acre in developing areas can be high: the Soil Conservation Service has estimated that about 120 cubic yards/acre/year (roughly 180 tons) are lost in representative metropolitan areas.

Reference:
--See Section V, Stormwater Management.